GENERAL LIBRARY
MAY 1 - 1922
UNIV. OF MICH.

MAY 1 1922

The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

THE ANDES BERRY

MENDELISM IN SHEEP CROSSES

EXPERIMENTAL GIGANTISM IN SALAMANDERS

INFLUENCE OF THE THYROID GLAND UPON GROWTH

USE OF GREENHOUSE IN CORN BREEDING

COMPOUND FRUITS IN THE PEACH

ZEBRA STRIPED MAIZE LEAVES

COIX AND SORGHUM

PUBLISHED MONTHLY AT MENASHA, WISCONSIN
BY THE
AMERICAN GENETIC ASSOCIATION
EDITORIAL AND GENERAL OFFICES
WASHINGTON, D. C.

Volume XII, Number 9 November, 1921

The American Genetic Association

President, DAVID FAIRCHILD

Vice-President, W. E. CASTLE

Secretary, E. W. SHEETS

Treasurer, BOYD TAYLOR

Honorary Vice-Presidents: ALEXANDER GRAHAM BELL and MRS. E. H. HARRIMAN

First President, JAMES WILSON. *First Secretary*, WILLET M. HAYS

Editorial Board:

G. N. COLLINS
WILSON POPENOE
T. H. KEARNEY
SEWALL WRIGHT
E. W. SHEETS
C. E. LEIGHTY
PAUL POPENOE
FREDERICK ADAMS WOODS
GEO. M. DARROW

Managing Editor, OLIVER OLSON

COUNCIL

W. E. CASTLE, Professor of Zoology, Harvard University, and Research Associate of the Carnegie Institution of Washington; Cambridge, Mass.

G. N. COLLINS, Botanist, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

O. F. COOK, Bionomist in Charge of Office of Crop Acclimatization, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

DAVID FAIRCHILD, Agricultural Explorer in Charge of Foreign Seed and Plant Introduction, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

GILBERT GROSVENOR, President National Geographic Society, Washington, D. C.

J. H. KEMPTON, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

E. W. SHEETS, Acting Chief of Animal Husbandry Division, Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C.

FREDERICK ADAMS WOODS, Lecturer on Biology, Massachusetts Institute of Technology.

SEWALL WRIGHT, Senior Animal Husbandman in Animal Genetics, Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C.

COMMITTEES ON RESEARCH

Plant Breeding

WALTER T. SWINGLE, Chairman, Physiologist in Charge of Crop Physiology and Breeding Investigations, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.
A. B. STOUT, Director of Laboratories, New York Botanical Garden, New York.
HERBERT J. WEBBER, Secretary, Professor of Plant Breeding, University of California, Director of Citrus Substation and Dean of Graduate School of Tropical Agriculture, Riverside, Cal.
HARVEY J. SCONCE, Sidell, Illinois.
H. HAROLD HUME, Glen Saint Mary Nurseries, Glen Saint Mary, Fla.
R. A. EMERSON, Professor of Plant Breeding, Cornell University, Ithaca, N. Y.
D. F. JONES, Professor of Plant Breeding, Connecticut Agricultural Experiment Station, New Haven, Conn.
A. D. SHAMEL, Pomologist, U. S. Department of Agriculture, Riverside, Cal.

Animal Breeding

LEON J. COLE, Chairman, Professor of Genetics, University of Wisconsin, Madison, Wis.
T. S. PALMER, Vice-Chairman, Assistant Chief of Biological Survey, Washington, D. C.
CHARLES R. STOCKARD, Secretary, Professor of Anatomy, Cornell Medical College, New York, N. Y.
C. C. LITTLE, Carnegie Institution of Washington, Cold Springs Harbor, Long Island, N. Y.
J. A. DETLEFSEN, Professor of Genetics, College of Agriculture, Urbana, Illinois.
E. N. WENTWORTH, Armour & Company, Chicago, Ill.
E. A. McILHENNY, Avery Island, La.

Eugenics

FREDERICK ADAMS WOODS, Chairman, Lecturer on Biology, Massachusetts Institute of Technology.
ADOLF MEYER, Vice-Chairman, Professor of Psychiatry, Johns Hopkins University, and Director of Henry Phipps Psychiatric Clinic, Johns Hopkins Hospital, Baltimore, Md.
CHARLES B. DAVENPORT, Secretary, Director Department of Experimental Evolution (Carnegie Institution of Washington), Cold Springs Harbor, Long Island, N. Y.
HOMER FOLKS, Secretary, State Charities Aid Association, New York City.
THOMAS W. SALMON, Medical Director, National Committee for Mental Hygiene, New York City.
EDWARD L. THORNDIKE, Professor of Educational Psychology, Columbia University.
MRS. CHARLES CARY RUMSEY, New York, N. Y.

The Journal of Heredity

(Formerly the American Breeders' Magazine)

VOL. XII, No. 9 NOVEMBER, 1921

CONTENTS

THE ANDES BERRY ..... WILSON POPENOE 387

THE USE OF THE GREENHOUSE IN CORN BREEDING ..... FREDERICK D. RICHEY 393

WAXY ENDOSPERM IN COIX AND SORGHUM ..... J. H. KEMPTON 396

INHERITANCE OF WEBBED TOES ..... RICHARD SCHOFIELD 400

MOTHERHOOD (review) 401

COMPOUND FRUITS IN THE PEACH RESULTING FROM MULTIPLE PISTILS ..... R. E. KARPER 403

HERITABLE CHARACTERS OF MAIZE—ZEBRA STRIPED LEAVES ..... M. DEMEREC 406

EXPERIMENTAL GIGANTISM IN SALAMANDERS ..... E. UHLENHUTH 408

MENDELISM IN FUR SHEEP CROSSES ..... RUSSELL W. DUCK 410

EVOLUTION AND SOCIAL PROGRESS (review) 413

INFLUENCE OF THE THYROID GLAND AND HYPOPHYSIS UPON GROWTH AND DIFFERENTIATION ..... BENNETT M. ALLEN 414

AN UNUSUAL TYPE OF PROLIFERATION IN AGROPYRON CRISTATUM ..... C. V. PIPER 423

PHOTOGRAPHS SHOWING SAME FAMILY FROM YOUTH TO MATURITY 425

THE SWAZEY BARBERRY ..... F. T. RAMSEY 426

A BEQUEST TO THE AMERICAN GENETIC ASSOCIATION FOR RESEARCHES IN HEREDITY 428

A STUDY OF PHYSICAL VIGOR OF AMERICAN WOMEN (review) 431

WHAT IS MAN? (review) 432

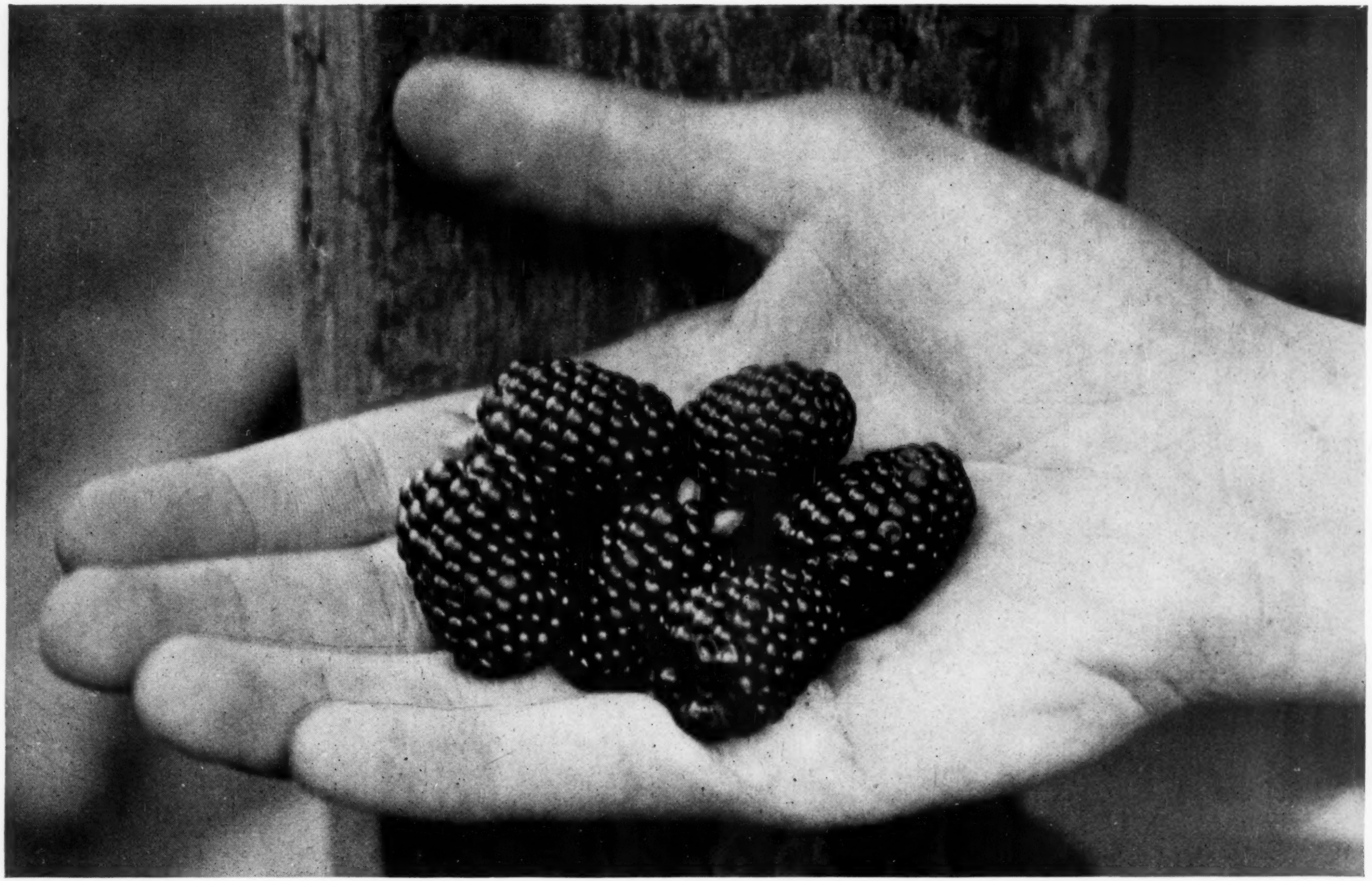
The JOURNAL OF HEREDITY is published monthly by the
AMERICAN GENETIC ASSOCIATION

Publication office, 450 Ahnaip Street, Menasha, Wis.
Editorial and general offices, Washington, D. C.

Entered as second-class matter May 13, 1921, at the postoffice at Menasha, Wisconsin. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized Dec. 20, 1918.

Contents copyrighted 1921 by the American Genetic Association. Reproduction of articles or parts of articles permitted only upon request, for a proper purpose, and provided due credit is given to author and to the JOURNAL OF HEREDITY (Organ of the American Genetic Association, Washington, D. C.), Menasha, Wisconsin. Address all communications to the Association's office at Washington, D. C.

Date of issue of this number, April 15, 1922.



A HANDFUL OF ANDES BERRIES

These luscious fruits, which resemble loganberries in character but are somewhat sweeter and richer in flavor, are produced by an immense, raspberry-like bramble which grows wild in the region between southern Mexico and Peru, and is cultivated in Colombia and Ecuador. They can probably be grown in several parts of the United States, and in addition, the species should be of great interest to plant breeders for crossing with our cultivated raspberries. The specimens here shown, slightly reduced in size, were picked from wild plants on the volcano Irazú, in Costa Rica. (Frontispiece.)

THE ANDES BERRY

WILSON POPENOE
Agricultural Explorer, United States Department of Agriculture

SCATTERED throughout the highlands of tropical America, mainly at elevations between 4,000 and 10,000 feet, are many species of Rubus, some of which produce excellent fruits. Few of them, however, are seen in cultivation, though the juicy berries of a dozen or more are sometimes gathered from wild plants and carried to the markets of large cities such as Guatemala, Bogotá, and Quito.

Rubus glaucus Benth., the Andes berry (as it may well be called, after the region in which it grows most abundantly) is certainly one of the most valuable. This species occurs as a wild plant in several countries, and is cultivated in at least two,—Colombia and Ecuador. That a fruit of such excellent quality should have escaped the attention of North American horticulturists until very recently seems difficult of explanation. Unlike the Colombian berry (*Rubus macrocarpus*), described in a recent number of the JOURNAL OF HEREDITY, its distribution is not limited to a narrow and rather inaccessible zone in the higher Andes: not only is it common as a wild plant throughout an extensive area, but it is also abundant in the gardens of numerous towns and villages.

In character of growth and foliage this species closely resembles the black raspberry, while the fruits are more like our blackberries in character. For this reason it does not seem proper to call it the "Andes raspberry," nor yet the "Andes blackberry." The canes, which are trailing to half-erect, are covered with whitish bloom, and root freely at the tips; the leaves are trifoliate, like those of the black raspberry; and the fruit-clusters are similar to those of the latter. The luscious fruits, in place of pulling off (separating from the torus or receptacle) as do our raspberries, must be picked like blackberries. The receptacle remains firmly attached within the fruit, and the calyx adheres to its base.

In this connection, it is worthy of mention that the Colombian berry presents conditions just the reverse of this. Its canes, leaves, and flowers resemble those of our northern blackberries, while its huge fruits are raspberries, if judged by our present standard, since they pull off the torus when fully ripe, leaving the latter attached to the plant. In other words, the Andes berry is a raspberry in growth but a blackberry in fruit, while the Colombian berry is a blackberry in growth and a raspberry in fruit. Our present classification will have to be altered somewhat if it is to include these tropical American species.

A VARIABLE SPECIES

Traveling down the Andes in search of new food-plants for introduction into the United States, I was much interested by the wide range of variation exhibited by plants, both wild and cultivated, of *Rubus glaucus*.[1] Differences in the size, color, and quality of the fruits were particularly striking. Some of the varieties are, to my mind, superior to our northern raspberries in flavor, as well as in size.

I had picked many of these berries from wild plants in the mountains, and had enjoyed them; but a full ap-

[1] Since this species is not well known to North American botanists, I append the following brief characterization: Canes trailing to suberect, up to 5 m. long; branches, panicles, and petioles glabrous, glaucus-pruinose, armed with recurved thorns; leaves pinnately trifoliate, the leaflets ovate-lanceolate, long-acuminate, glabrous above and white tomentose beneath; flowers about 2 cm. broad, in few-flowered leafy panicles, the sepals long-acuminate, petals white, nearly as long as the sepals; fruits oblong to cordate, 2 to 4 cm. long, light to dark purplish red, composed of numerous drupelets which are pilose when immature.

preciation of their rich flavor, juiciness, and freedom from objectionable seeds did not come until I was served, at Charles J. Eder's home in the beautiful Cauca valley of Colombia, a saucer of thoroughly ripe ones, with cream and sugar. The scarcity of the former article in the Andean region makes it difficult for the agricultural explorer to test such fruits as blackberries and raspberries under conditions comparable with those to which he is accustomed in the United States. There are, I believe, a number of berries in the Andes which would compare favorably with our own, if served in the same fashion; but when one buys them in the market, picked before fully mature and badly bruised in transit, and eats them without the customary concomitants, he is not certain to appreciate them at their full value.

I first came upon the Andes berry in the highlands of northern Guatemala. Here it is found, in the region of Coban, at elevations of 4,000 to 6,000 feet. It is not abundant, as it is in northern South America, nor have I ever seen plants of such large size as in the latter region. Indeed, in Guatemala it usually occurs in the form of a straggling or trailing bush not over six or eight feet in height. It frequents clay soils, and open, sunny places.

The fruits produced by these wild plants in Guatemala (for I never saw it cultivated in that country) are oblong, up to an inch and a half in length, and dark maroon. They remind one of loganberries, except that they are broader in form and somewhat sweeter in taste. They have small, soft seeds, and are very juicy. The flavor is rich and delicious. The Indians, as they wander over the mountainsides, gather and eat them, but the quantity available is never large enough to warrant carrying the fruit to market, —at least, I have never seen it on sale in any of the Guatemalan towns. The Kekchi know this berry as *uuk-tokan;* the latter word is applied to several species of Rubus, and the prefix *uuk* is used to designate this particular one. We have here, in fact, another example of the remarkable binomial nomenclature employed by the Guatemalan Indians of Maya descent, a system which recognizes botanical relationships, in a limited way, and which probably has been in existence since long before the Conquest.

In Costa Rica I again found the plant, growing abundantly upon the slopes of the volcano Irazú at elevations between 6,000 and 7,000 feet. In certain places it forms solid stands, twenty or thirty yards in diameter. The plants are suberect in habit, and reach about six feet in height. The fruits are different from those seen in Guatemala, being somewhat smaller, lighter red in color, and not so rich in flavor. Botanical specimens collected here, however, prove that the plant is not specifically different from the one studied in Guatemala, hence we can only conclude that we are dealing with a variation such as those which give rise to horticultural forms.

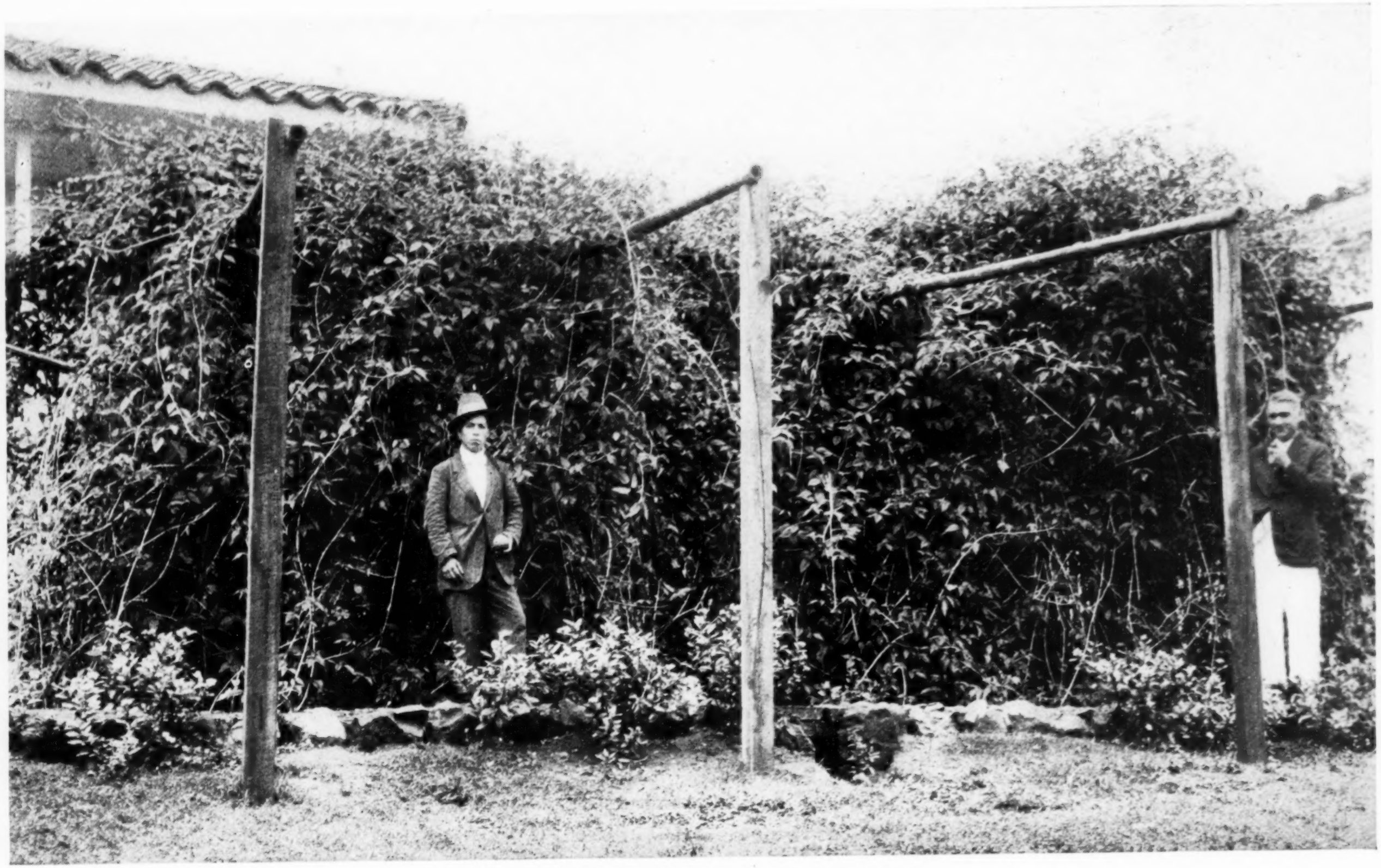
ABUNDANT IN COLOMBIA

Upon reaching the highlands of Colombia, in the department of Cundinamarca, I again found *Rubus glaucus* growing as a wild plant, and here, for the first time, I saw its luscious fruits offered in the markets. In the city of Bogotá they can be obtained during a large part of the year; they are sold under the name of *mora de Castilla*, which does not, however, serve to distinguish them from the fruits of other species of Rubus, since several which grow wild in this region are commonly sold under the same name. The use of the term *mora*, originally meaning *mulberry* in Spanish, has been extended in Latin America to include many fruits of the genus Rubus. To indicate a variety of superior quality the Colombians generally add the phrase *de Castilla* (*Castilian*), a usage which has come down from Colonial days, when the best of everything was supposed to come from the Mother Country.

The plant is found in considerable abundance upon the mountainsides not far from Bogotá, mainly at eleva-

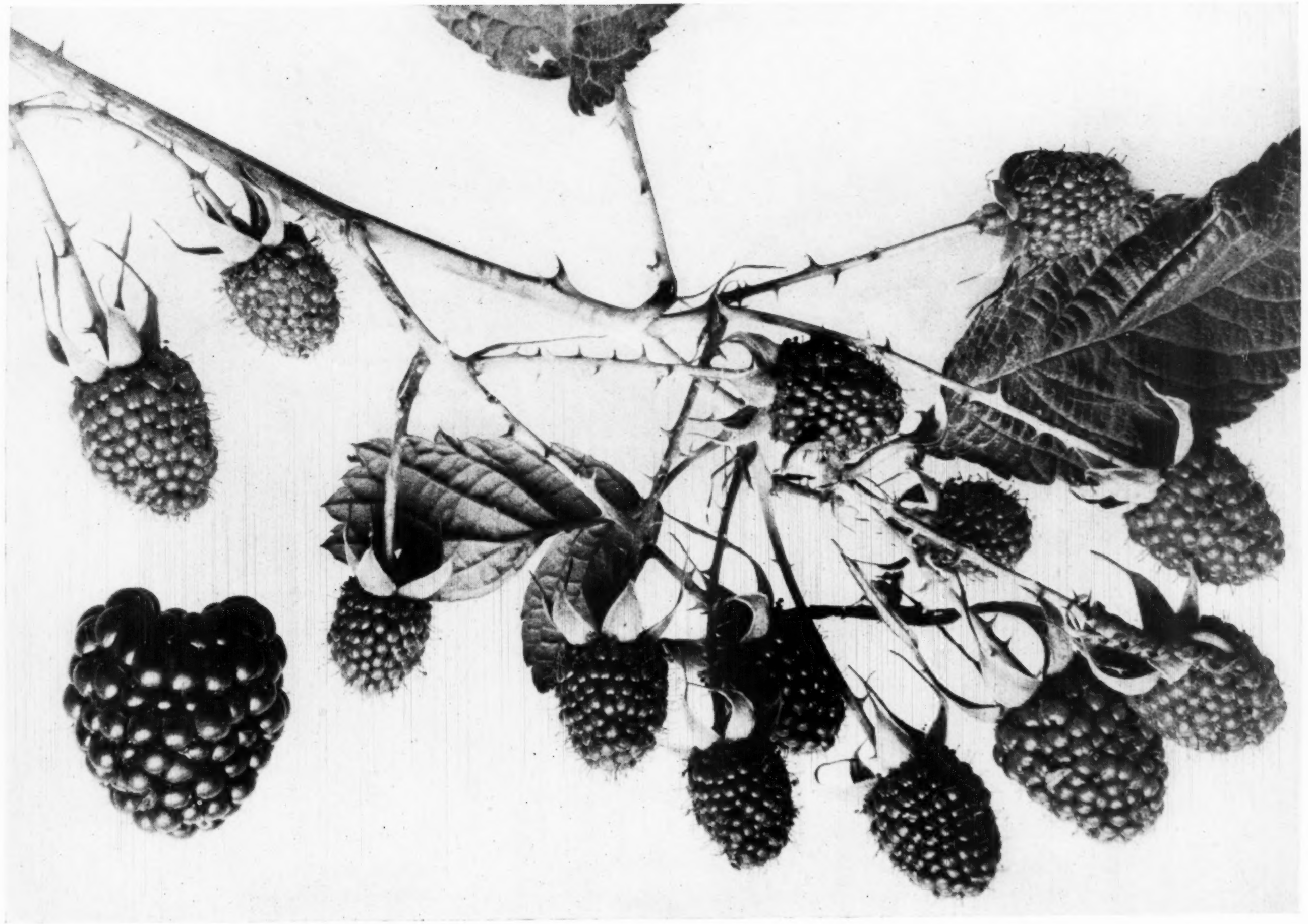
FOLIAGE, FLOWERS AND FRUIT, NATURAL SIZE

In character of growth the Andes berry is similar to our cultivated raspberries: the canes are glaucous, the leaves trifoliate (although the few shown above, arising from a flower-panicle, are simple) and the flowers white. The fruit, however, does not separate from the torus or receptacle, as does the raspberry, but more closely resembles our blackberries in character. Photographed at Ambato, Ecuador. (Fig. 1.)



TWO PLANTS IN WESTERN COLOMBIA

To plant breeders, the unusual vigor of the Andes berry is of great interest, as offering a valuable characteristic for combination, by means of hybridization, with our cultivated raspberries. The tangled mass of foliage shown above is derived from two plants growing in the grounds of the American Hospital at La Cumbre, near Cali, in western Colombia. It seems probable that more berries would be produced if the plants were pruned for the production of fruiting laterals, instead of being allowed to develop unchecked as is invariably the case in South America. (Fig. 2.)



A CLUSTER OF IMMATURE ANDES BERRIES, AND A SINGLE MATURE ONE

The fruits are borne on leafy panicles, and when fully ripe are light red to deep maroon in color, soft and juicy in texture, with small, soft seeds. Although the species has not had the benefit of intelligent cultivation with a view to improving the size and quality of the fruit, Andes berries are perhaps superior to most of our cultivated raspberries in flavor and quality. The fruits here shown, natural size, were produced by cultivated plants at Ambato, Ecuador. (Fig. 3.)

tions of 6,000 to 8,000 feet. The fruits appeared to me somewhat darker in color than most of those I had seen in Costa Rica, but not quite so large, soft, and luscious as those of northern Guatemala. I saw no plants in cultivation in this part of Colombia, but after crossing the Quindio pass and traveling up the Cauca valley, I found at La Cumbre, a small station on the railroad between Cali and the Pacific port of Buenaventura, a few plants growing in the garden of an American hospital. This was the first time I had seen the species in cultivation, but I was soon to become familiar with it in Ecuadorean gardens. Here at La Cumbre (elevation about 5,200 feet), in the western cordillera of the Andes, I was impressed by the luxuriant growth which the species makes when brought into cultivation. Two specimens covered a huge arbor 25 feet long by 10 feet in breadth and height, and furnished enough fruit to supply the hospital staff with excellent sauce and jelly. Yet I am convinced that much more fruit would be produced if the plant were systematically pruned. Fruiting laterals are not developed in great abundance by these huge plants; most of the fruit must therefore be borne on terminal clusters, which can never be very numerous.

It is in Ecuador that the Andes berry is best known, and horticulturally most important. Two towns, in particular, are noted for it: these are Ambato (8,500 feet) and Otavalo (8,100 feet). In both of these, plants are found in nearly every garden, and the fruit appears commonly in the markets; it is available throughout a large part of the year and is much used in the preparation of conserves and of a heavy syrup from which a refreshing drink is made. Otavalo is noted for this latter product.

I have seen, in Ecuador, two well-defined varieties of this berry, and have heard of a third. The common sort is deep maroon, about like the form observed in Guatemala, though slightly different in flavor, as far as I can compare the two by recollection. The second kind is light red—almost rose red—and is of a milder flavor than the common sort. The third one is said to be light pink, and for this reason is called *mora blanca* (white mora).

As in Colombia, the species occurs abundantly in Ecuador as an indigenous plant. I have seen it most commonly at elevations between 8,000 and 10,000 feet. In the wild state it is rarely over six or eight feet high, and not particularly vigorous in growth; but when brought into cultivation I have seen a single specimen cover the side of a small house, or reach several feet above a garden wall ten feet high.

CULTURAL NEEDS

In Ecuador, although it ranks as a cultivated plant, very little attention is given to its cultural requirements, and we can learn but little from an examination of the methods used by Ecuadorean horticulturists. No pruning is done, though it seems reasonable to believe that careful attention to this subject would result in far greater yields of fruit. It must be admitted that even the most productive plants observed in Ecuadorean gardens bear small crops, when compared with northern blackberries or raspberries. Probably this is largely due to the circumstance that they are allowed to develop too much wood, and are not pruned for the production of fruiting laterals.

I have seen wild plants upon clay soil, light sandy loam of volcanic origin, and rich alluvial loam. In northern Guatemala, they occur in a region where the rainfall is between 80 and 120 inches per annum, and is distributed through not less than ten of the twelve months. In Ecuador, on the other hand, they are sometimes found in places where the annual rainfall is not more than 15 or 20 inches.

Plants sent from Guatemala to the United States have been winter-killed at Washington, D. C., as would be expected of a species from an elevation of 5,000 feet in the latitude of the Central American countries. In Ecuador, wild plants are occasionally seen

at elevations of 10,000 to 11,000 feet, where light frosts are experienced; but it is not to be anticipated that the Andes berry will succeed in parts of the United States which are too cold for the loganberry. More probably its cultivation will be limited in this country to the Pacific Coast states, Arizona, New Mexico, and parts of Texas. Particular attention may be directed to its value for plant breeders: because of its vigor, and the large size and good quality of its fruit, it seems likely to prove an excellent subject for crossing with some of our northern raspberries.

THE USE OF THE GREENHOUSE IN CORN BREEDING

FREDERICK D. RICHEY

Agronomist in Corn Investigations, Office of Cereal Investigations, Bureau of Plant Industry, U. S. Department of Agriculture

THE improvement of corn by selection within self-fertilized lines necessarily is a slow process, and any method that will shorten the time required is highly desirable. It has been shown that sweet corn is adapted for forcing under glass.[1] The greenhouse also has been used successfully in inheritance studies with corn as shown by casual reference in several articles. The author is informed by Mr. G. N. Collins, however, that attempts to grow corn during the winter—that is, planted in the fall—in the greenhouse have not been successful. The plants under such conditions have failed to develop normally and have ripened prematurely with a scanty production of seed. The following notes indicate that under some conditions such practice is entirely successful. The determining differences are not known, and these notes are offered to indicate the practicability of this method, with the hope that interest in the possibilities of greenhouse culture may be promoted.

USE OF THE GREENHOUSE

The crop was grown in one of the department greenhouses at the Arlington Farm, Rosslyn, Virginia, during the winter of 1920-21. The center space was excavated to a depth of 12 inches and filled with good soil. Under greenhouse conditions the secondary roots of corn frequently originate abnormally near, and in extreme cases even above, the soil surface. To nullify the effect of this tendency the seed was planted in the bottom of a 6-inch furrow which was not filled in until the root system had become well established. This method proved very effective.

After emergence the plants were thinned to a stand that provided 1.67 square feet per plant. This is at the rate of over 25,000 plants per acre, and was entirely too thick, as, although there was plenty of moisture and fertility, it interfered with proper light distribution. It is thought that a rate allowing three square feet per plant would utilize the space to good advantage.

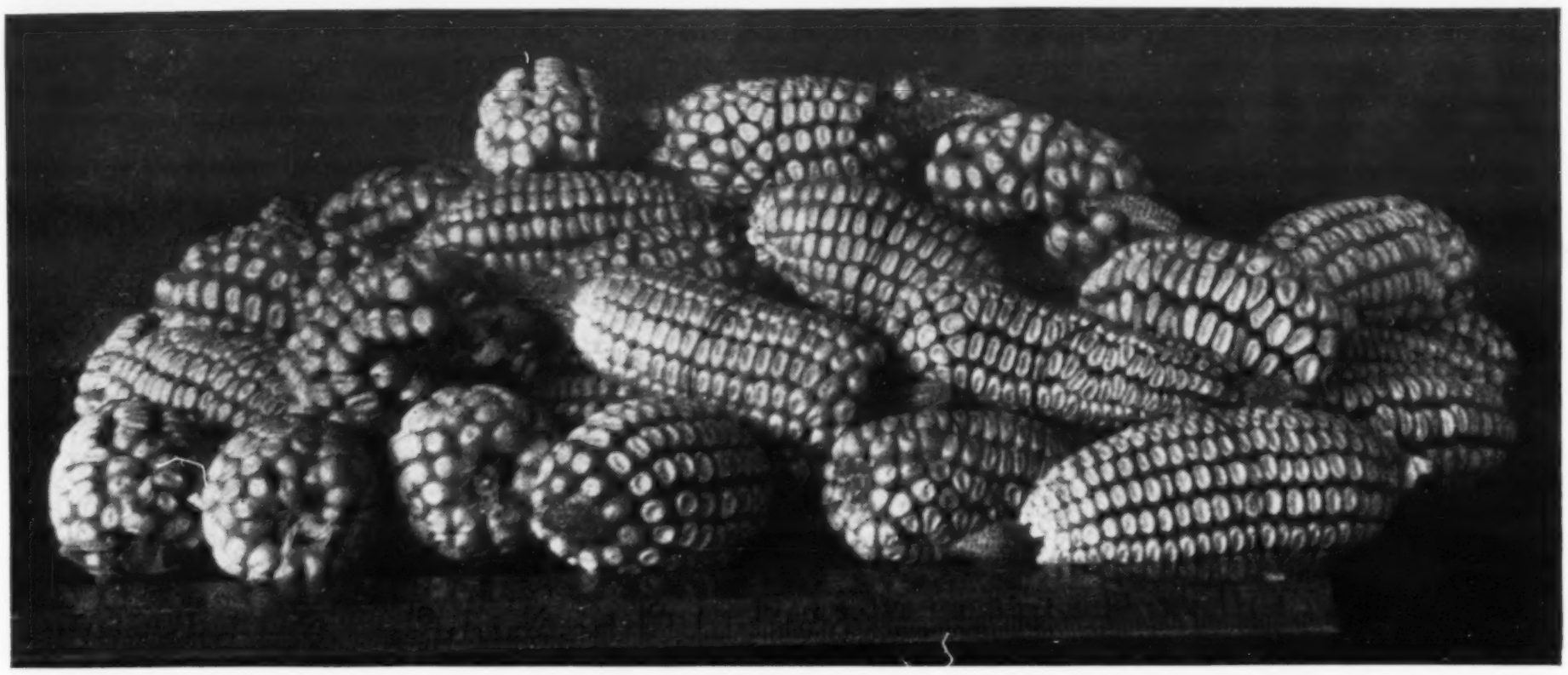
The following strains were grown: 8 plants of Gerrick that had been self-fertilized for five generations; 24 plants of a Chinese dent variety, self-fertilized for one generation; and 20 plants of a chlorophyll-deficient, brachytic strain of U. S. Selection No. 201 that had been self-fertilized for three generations. Two ears were obtained from the Gerrick, none from the No. 201, and a few seeds on each of three cobs from the Chinese variety.

There also were 116 plants from 58 F_1 crosses between self-fertilized strains of U. S. Selection No. 201. The following notes refer to these cross-bred plants.

[1] Rane, F. W. Green Corn Under Glass. N. H. Agr. Expt. Sta. Bull. 60. 1899.

CORN PLANTS IN THE GREENHOUSE AT ARLINGTON FARM, VA.

Under some conditions the growing of corn, for experimental purposes, in greenhouses has been found practicable. This method shortens the time necessary for the plants to mature. The photograph shows some crossbred plants of U. S. Selection 201 grown at the Arlington Farm in the winter of 1920–21 photographed 105 days after emergence. (Fig. 4.)



GREENHOUSE-GROWN CORN

These fifty-four ears were produced by the plants shown in Fig. 4. The flowers were pollinated by hand; although the ears are small, the seeds are well-developed, "the average weight of 100 from each ear being 28.5 grams in comparison with an average of 28.9 grams per 100 seeds of the parents." These ears were harvested 153 days after the emergence of the plants. (Fig. 5.)

Emergence was complete on October 19, 7 days after planting. The temperature was maintained at from 70° to 90° F. during the day and at from 68° to 70° F. at night. Under these temperatures and with the unusually bright weather that obtained during the winter, the plants developed rapidly, and were 32 to 40 inches high on November 26, 38 days after emergence. The plants silked between January 7 and 21, or in from 80 to 94 days after emergence. In contrast, the parent strains silked in from 65 to 79 days after planting, when grown under field conditions in Arkansas in 1920. The plants grown in the greenhouse were vigorous and attained a good size. This is shown in Fig. 4, which gives a general view of the house on January 31. The cross braces in this illustration are six feet high.

The 54 hand-pollinated ears shown in Fig. 5 were harvested on March 21, 153 days after the plants emerged. Thirty-eight of these ears were self-fertilized, and although small, there were enough seeds to answer the purpose. The seeds were well developed, the average weight of 100 from each ear being 28.5 grams, in comparison with an average of 28.9 grams per 100 seeds of the parents. Kernels from these selfed ears have been planted, have given as good a stand as field grown seed, and will be used as the basis for a second cycle of selection within self-fertilized lines. The use of the greenhouse, therefore, has saved a full year in the accomplishment of the breeding program.

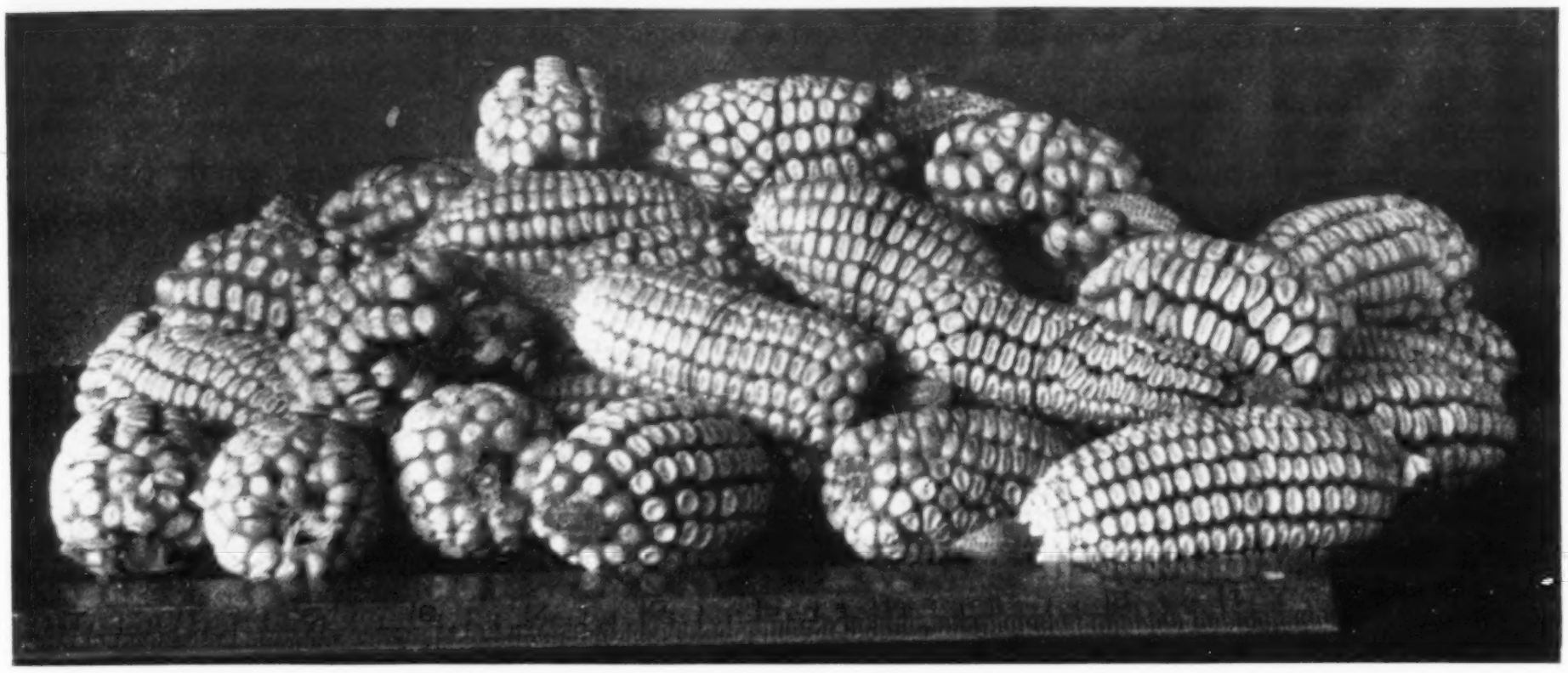
DISCUSSION

The greenhouse does not seem to offer much usefulness in the earlier years of selection from a commercial variety of corn. The percentage of culls is so large during these years that field conditions seem essential to provide enough material for selection. However, in later years there are many phases of the corn breeding problem that suggest themselves as being adapted to greenhouse manipulation, and it seems that if breeding operations were on any considerable scale, the maintenance of greenhouse facilities for annual use in connection with them would be entirely warranted.

The height of the corn plant, its need for abundant room, and the necessity for maintaining relatively high temperatures, require the provision of special facilities planned for this particular crop. The best type of house is one that has no side benches and has as low a solid wall as possible. The light requirement seems of the

CORN PLANTS IN THE GREENHOUSE AT ARLINGTON FARM, VA.

Under some conditions the growing of corn, for experimental purposes, in greenhouses has been found practicable. This method shortens the time necessary for the plants to mature. The photograph shows some crossbred plants of U. S. Selection 201 grown at the Arlington Farm in the winter of 1920–21 photographed 105 days after emergence. (Fig. 4.)



GREENHOUSE-GROWN CORN

These fifty-four ears were produced by the plants shown in Fig. 4. The flowers were pollinated by hand; although the ears are small, the seeds are well-developed, "the average weight of 100 from each ear being 28.5 grams in comparison with an average of 28.9 grams per 100 seeds of the parents." These ears were harvested 153 days after the emergence of the plants. (Fig. 5.)

Emergence was complete on October 19, 7 days after planting. The temperature was maintained at from 70° to 90° F. during the day and at from 68° to 70° F. at night. Under these temperatures and with the unusually bright weather that obtained during the winter, the plants developed rapidly, and were 32 to 40 inches high on November 26, 38 days after emergence. The plants silked between January 7 and 21, or in from 80 to 94 days after emergence. In contrast, the parent strains silked in from 65 to 79 days after planting, when grown under field conditions in Arkansas in 1920. The plants grown in the greenhouse were vigorous and attained a good size. This is shown in Fig. 4, which gives a general view of the house on January 31. The cross braces in this illustration are six feet high.

The 54 hand-pollinated ears shown in Fig. 5 were harvested on March 21, 153 days after the plants emerged. Thirty-eight of these ears were self-fertilized, and although small, there were enough seeds to answer the purpose. The seeds were well developed, the average weight of 100 from each ear being 28.5 grams, in comparison with an average of 28.9 grams per 100 seeds of the parents. Kernels from these selfed ears have been planted, have given as good a stand as field grown seed, and will be used as the basis for a second cycle of selection within self-fertilized lines. The use of the greenhouse, therefore, has saved a full year in the accomplishment of the breeding program.

DISCUSSION

The greenhouse does not seem to offer much usefulness in the earlier years of selection from a commercial variety of corn. The percentage of culls is so large during these years that field conditions seem essential to provide enough material for selection. However, in later years there are many phases of the corn breeding problem that suggest themselves as being adapted to greenhouse manipulation, and it seems that if breeding operations were on any considerable scale, the maintenance of greenhouse facilities for annual use in connection with them would be entirely warranted.

The height of the corn plant, its need for abundant room, and the necessity for maintaining relatively high temperatures, require the provision of special facilities planned for this particular crop. The best type of house is one that has no side benches and has as low a solid wall as possible. The light requirement seems of the

greatest importance, and such a house would allow utilization of the full supply. The results of Garner and Allard[2] suggest, too, that artificial lighting may be used to supplement the natural supply, and to obtain the optimum relation between periods of light and dark.

The details are for the future. For the present it seems enough to point out the advantages of speeding up the progress by growing two crops a year, and the desirability of determining the best practice in greenhouse corn culture as well as the possibilities and limitations of such a method in corn breeding.

WAXY ENDOSPERM IN COIX AND SORGHUM

J. H. KEMPTON
Bureau Plant Industry, United States Department of Agriculture

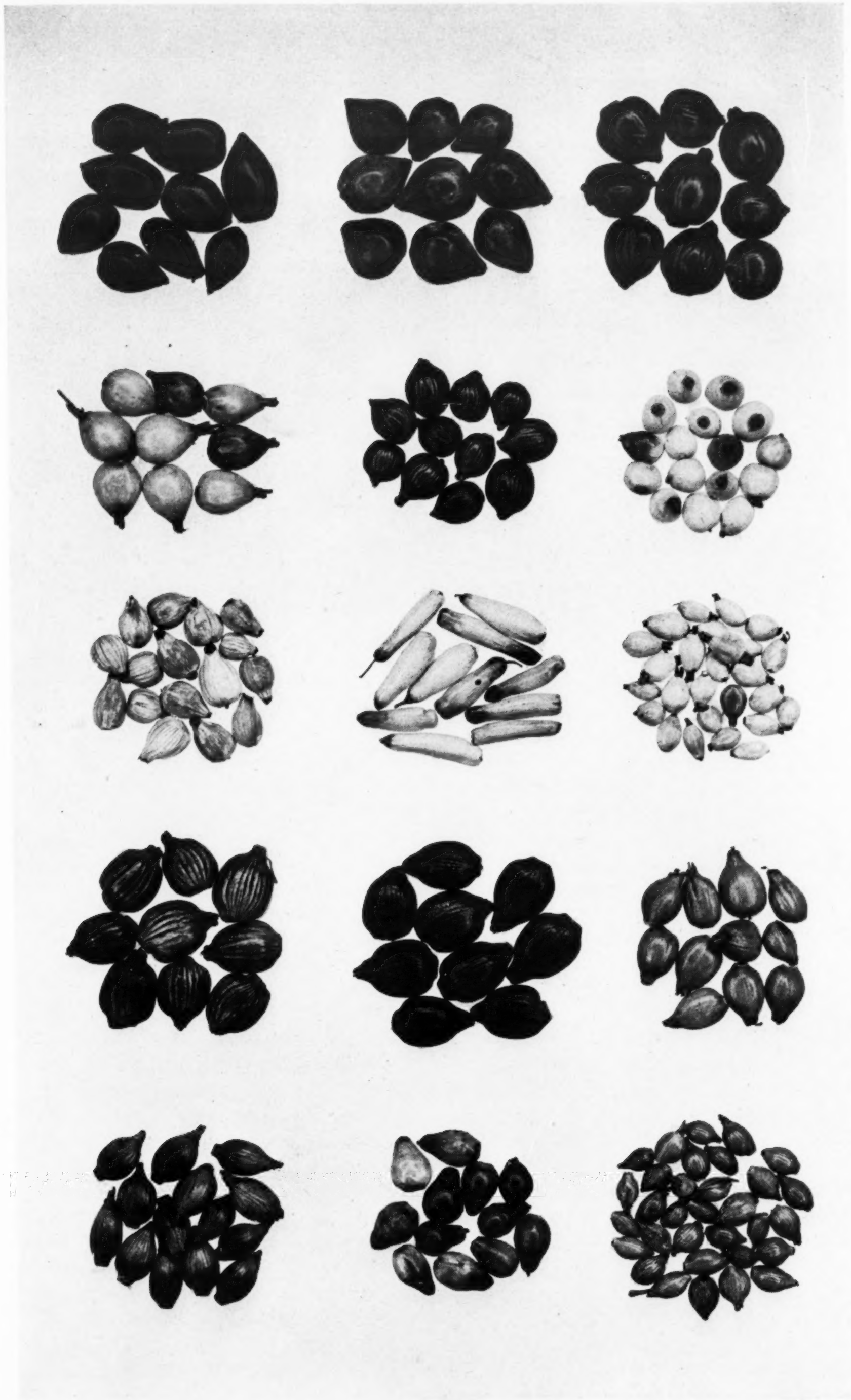
IN THE endosperm of maize seeds, a layer of compact starch cells, variable in thickness, encloses the loose or soft starch cells that occupy the center of the seed adjacent to the embryo. This layer of compact or hard starch cells is found in three visibly different, genetically distinct types, commonly known as horny, sweet, and waxy. Each of these types is distinguished easily from the others and from the soft type or central starch. The horny type is coextensive with maize and is the common form of endosperm, not only in maize but in most grasses. The sweet and waxy types have been reported only in maize and are restricted in distribution—the former in the Americas, and the latter in Asia. Sweet endosperm is distinguished from the common, horny form, chiefly in the wrinkling of the seed caused by the drying of imperfect starch cells. In the smaller seeded grasses, this characteristic wrinkling might be overlooked easily, or be attributed to immaturity or imperfect fertilization. However, crosses between maize with sweet endosperm and Euchlaena, the nearest American wild relative, have given only horny seeds in the first generation, indicating that the sweet type of endosperm is not common in Euchlaena.

Waxy endosperm differs from the horny in texture and in being opaque instead of translucent. It was found first in maize from China and later in maize from Burma and the Philippines. Maize varieties from other parts of the world have been scrutinized carefully for this type of endosperm, but thus far it has been found only in the three widely separated regions of Eastern Asia. The common occurrence of waxy endosperm in the Shan states of upper Burma with an extensive vocabulary of native maize names has led Collins to the conclusion that this type of endosperm originated in Burma and was distributed from there to China and thence to the Philippines.[1]

A waxy type of endosperm has been found now in several varieties of Coix (Job's tears) and also in one variety of sorghum. In appearance this type of endosperm in Coix is entirely similar to the waxy endosperm of maize, and presents the same sharp contrast with the horny endosperm as well as with the loose, or floury portion of the kernels. It may be expected that in Coix as in maize the waxy endosperm will behave as a definitely, alternative character, recessive to the horny form. From the standpoint of the origin of waxy endosperm in maize it seems suggestive that waxy endosperm in Coix is found in the same isolated regions in Eastern Asia, and as with maize, Burma seems to be the most important center.

[2] Garner, W. W., and Allard, H. A. Effect of the relative length of day and night factors of the environment on the growth and reproduction in plants. In Journ. Agr. Res., v XVIII, no. 11, pp. 553-606. 1920.

[1] Collins, G. N. Waxy maize from upper Burma. Science, N.S., Vol. LII 770 1333 pp. 48-51, July 16, 1920.



VARIOUS TYPES OF JOB'S TEARS

The plant known as Job's tears (Coix lachryma-jobi), an Asiatic relative of maize, is grown not only as a source of beads, but also as a cereal. The seeds of the lower six groups shown in this photograph have the waxy type of endosperm first found in maize from China. Most of the samples which have waxy endosperm are soft-shelled, the one exception being the central group in the lower row, which is hard-shelled. The central group in the upper row is the form commonly cultivated in Europe and America as a source of beads.

Beginning at the upper left-hand corner, the sources of seed and localities from which they came will be found in the table in the following order: 34, 49, 4, 37, 43, 27, 18, 21, 11, 8, 13, 45, 33, 36, 45. The seeds are natural size. (Fig. 6.)

	Locality	*Variety*	*Source of Seed*		*Type of Shell*	*Type of Endosperm*
1	So. Shan States, Burma		S.P.I.[2]	38870	Hard	Horny
2	"		"	38871	Soft	Waxy
3	"	Ma Yuen	"	38873	"	"
4	"	Ma Yuen	"	38874	"	Horny
5	"	Stenocarpa	"	38875	Hard	"
6	"		"	38876	"	"
7	"	Ma Yuen	"	38877	Soft	"
8	"	"	"	38878	"	Waxy
9	"	"	"	38879	"	"
10	"	"	"	38872	"	Horny
11	"	Monilifer	"	38880	Hard	"
12	"	Ma-Yuen	"	44813	Soft	Waxy
13	"	"	F.H.B.[3]	28926	"	"
14	No. "	"	S.P.I.	37945	"	"
15	"	Stenocarpa	"	37946	Hard	Horny
16	"	Typica	"	38476	"	"
17	"		"	38474	"	"
18	"	Ma Yuen	"	38473	Soft	Horny
19	"	Gigantea	"	38475	Hard	"
20	"	Stenocarpa	F.H.B.	28920	"	"
21	"	"	"	28921	"	"
22	"	"	"	28922	"	"
23	"	"	"	28923	"	"
24	"	Ma Yuen	"	28924	Soft	Waxy
25	"	"	"	28925	"	Waxy-Horny
26	Mongpai, Burma	Stenocarpa	"	28878	Hard	Horny
27	"	"	"	28879	"	"
28	"	"	"	28880	"	"
29	"	Ma Yuen	"	28884	Soft	Waxy-Horny
30	"	Stenocarpa	"	28882	Hard	Horny
31	Lauksauk, Burma	Ma Yuen	"	28883	Soft	Horny
32	"	Stenocarpa	"	28881	Hard	"
33	Kachin Hills Myitkyina, Burma	Ma Yuen	"	28919	Soft	Waxy
34	Pegu, Burma	Gigantea	S.P.I.	38868	Hard	Horny
35	"	"	"	38869	"	"
36	Poona, India	Ma Yuen	F.H.B.	35933	"	Waxy-Horny
37	Saigon, Cochin-China		S.P.I.	36994	"	Horny
38	Buitenzorg, Java		"	37120	"	"
39	Singapore, Siam		"	37609	"	"
40	Mauritius		"	37227	"	"
41	Laguna, P. I.		"	47324	"	"
42	Los Baños, P. I.		*		"	"
43	Tangkulan Mindanao, P. I.	"	*		Soft	"
44	Kalasungay Mindanao, P. I.	"	*		"	"
45	Subanus, P. I. "		*		"	Waxy-Horny
46	China	"	†		"	"
47	China		S.P.I.	49345	Hard	Horny
48	Brazil		"	47617	"	"
49	U.S.A. Thorburn Seed Co.				"	"
50	U.S.A. Santa Barbara, Calif.				"	"

[2] The numbers following S.P.I. are the serial numbers of the importations made by the Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry, U. S. D. A.

[3] The numbers following F.H.B. are the serial numbers of the importations examined by the Federal Horticultural Board, U. S. D. A.

*Samples presented by Dr. William Weston, Jr.

†Sample presented by Dr. Yam Yei Kin.

Forty seven samples of *Coix lachryma jobi L.* from Eastern Asia have been examined, as well as three samples from the American hemisphere. These samples embrace several varieties of this species and include many of cultivated forms. The seeds vary greatly in size, shape, color, and hardness of shell, and the plants of those we have been able to grow are little less variable, some being grass-like, with numerous stalks and narrow leaves, while others with a few and thick culms and long broad leaves have more the appearance of maize or sorghum.

Although the diversity in Coix is great and it is possible to separate the seeds into widely different types, even the most extreme forms are said by Watt[4] to intergrade under cultivation. Several species of Coix have been described, but Watt accepts only two, *Coix gigantea Koen*, and *Coix lachryma-jobi-L.*, while other authorities consider all the known forms as varieties of *C. lachryma-jobi*. All cultivated forms are considered generally as varieties of C. *lachryma-jobi*, and those with a thin, loose and easily broken shell are known under the varietal name of Ma-Yuen. Practically all of the hard shell forms of *C. lachryma-jobi* are duplicated in the soft shelled series and Watt states that under continued cultivation, the hard shelled forms gradually become thin and papery. Coix has been cultivated for centuries, not only as a source of beads, but also as an important cereal in Burma, Assam, and northern India. As in maize, cross pollination is the rule, and it is not surprising, therefore, that with soft and hard shell forms growing side by side, few true breeding types are found. That interbreeding is the explanation of the change from hard to soft shells under continued cultivation is indicated by the hard shelled strain of *C. lachryma-jobi* which has been cultivated for centuries in Europe and America without losing to a noticeable degree the hardness of the shell.

The varietal names of the fifty samples examined, as well as the sources of the seed, the localities from which they came, and the type of shell and endosperm are shown in the preceding table:

Of the fifty samples, fourteen were found to contain seeds with waxy endosperm and of these eleven were from Burma, one from China, one from India, and one from the Philippines. Thirteen of the fourteen were of the soft shell type, but differed greatly in other respects. Ten of the samples from Burma contained waxy seeds only, two contained but a small percentage of horny seed, while in the samples from China, India, and the Philippines waxy and horny seeds were more nearly in equal numbers.

The discovery of waxy endosperm in Coix suggested the examination of the seeds of a Chinese sorghum received from Dr. Yam Yei Kin. This sample proved to have both waxy and horny seeds. A single panicle of *Andropogon sorghum* va. *negrosense* furnished by Dr. Weston had waxy seeds only. This sample was from Talim Island, Lak of Bay, Laguna Prov., P. I., and Dr. Weston states that the cultivation of this variety is restricted to the southern islands of the Philippines. No attempt has been made to canvass the other sorghums for this character, athough an examination of two or three of the commercial varieties showed only seeds with horny endosperm. The desirability of determining whether the waxy texture of the endosperm is confined to the Asiatic varieties of sorghum needs no emphasis, and it is important also that the wild species of Andropogonae be examined since this type of endosperm has been found thus far only in cultivated forms. Neither Tripsacum nor Euchlaena, the two American wild relatives of maize, seem to have waxy endosperm, and its occurrence in the Andropogonae and the Tripsaceae of Eastern Asia may add to other indications of the close relationship of these families.

[4] Watt, Sir George. Coix spp or Job's tears. A review of all available information. Vegetable Product Series No. 88. The Agri. Ledger No. 13, 1804, pp. 513-553.

In addition to the differences in endosperm texture the seeds of coix differ also in the color of the pericarp. The seeds of most of the hard shelled forms have a dark red pericarp while the pericarp color of many of the soft shelled seeds is a very light brown. Both red and brown pericarp colors are found in maize though by far the most common form is colorless, a form as yet not found in coix, while the only pericarp color known in Tripsacum and Euchlaena is a dark red. There is nothing to indicate whether the association in coix of the light brown pericarp with the soft shelled seeds is genetic or due simply to a discrimination against red pericarp in the cultivation of edible forms.

In maize the waxy texture of the endosperm has been found to be associated with the color of the aleurone cells of the seeds and also with a form of seed known as shrunken.[5] None of the samples examined had colored aleurone or shrunken endosperm but it is conceivable that with a larger series or by appropriate crosses these characters would be found, making it possible to compare their linkage relations in maize and coix. Even without this possibility coix should appeal to geneticists since the variability in seed and plant characters is great and the genus presents interesting morphological features.

INHERITANCE OF WEBBED TOES

Richard Schofield
University of California

IN THE family of the writer there occurs a curious type of webbed toes. The digits affected are the two nearest to the large toe on each foot, which are joined together by a webbed skin that persists as far out as the last joint. This webbing appears only in the skin and the superficial fascia, and in no way affects the bones. Sometimes the web extends a trifle beyond the last joint on the right foot, and in other cases it does not extend as far as the joint on the left foot. However this may be in any one case, it is found that the web persists always to a greater degree on the right than on the left foot. There is no noticeable inability to move either or both digits on account of the web of skin. The condition prevails at birth, not increasing as the individuals grow older.

The character always appears in the male sex, is transmitted only thru the male lineage, and it is never concealed in the males of this lineage. The daughter of an affected male may transmit the trait to her sons if this character behaved in no unusual manner, but as is shown in the accompanying chart this never occurs. Also it

DIAGRAM OF WEBBED TOES. (Fig. 7.)

will be noted that it is never handed down to a daughter by an affected male.

This peculiar hereditary trait is apparently inherited as a secondary sex character. Since this condition prevails in the family of the writer, there has been ample opportunity to examine the females equally as well as the males, and all conditions noted and given here have been verified.

[5] Hutchison, C. B. Heritable Characters of Maize—VII. Shrunken Endosperm. Journal of Heredity, Vol. XII, No. 2, Feb., 1921, pp. 76-83.

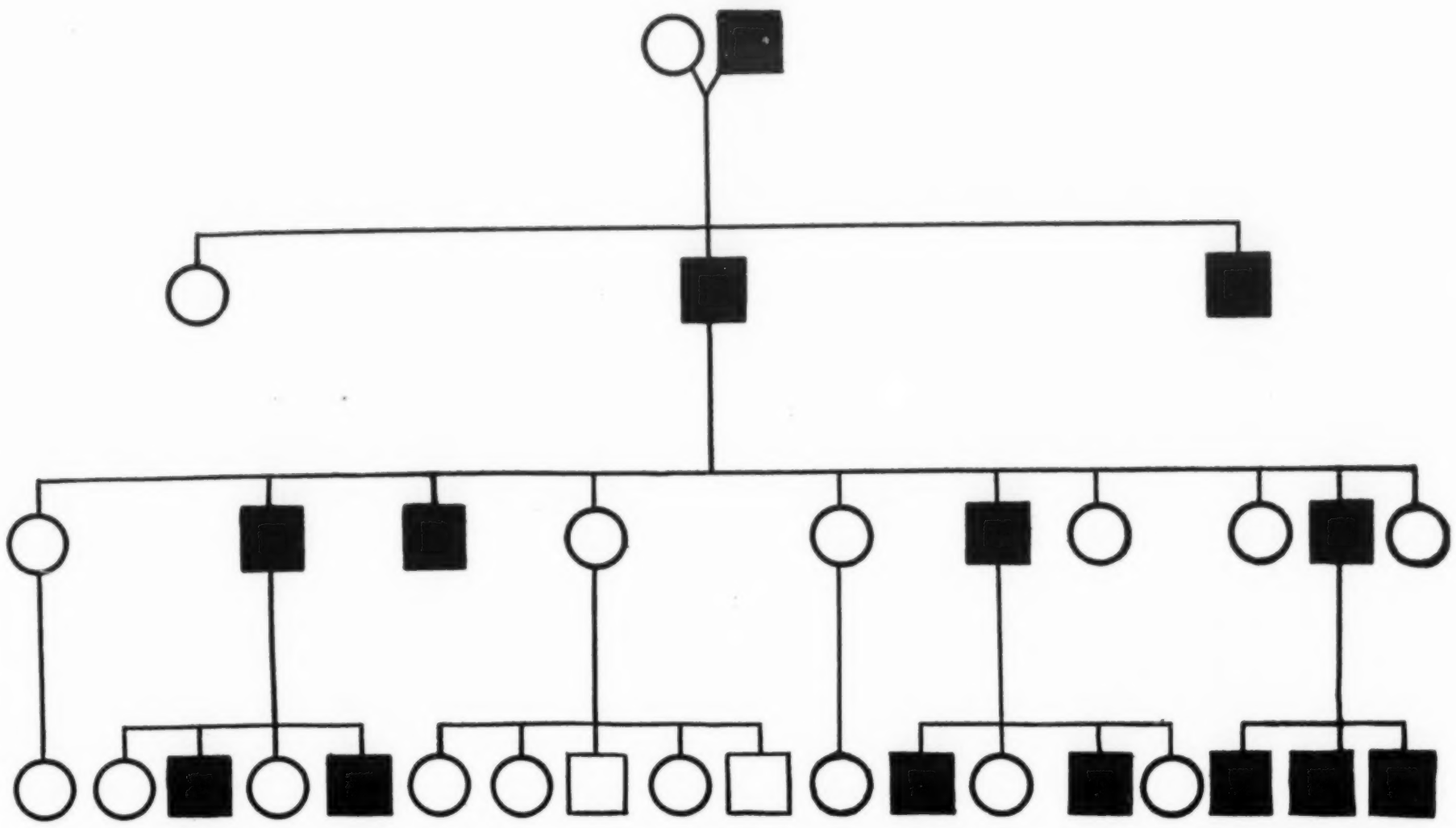


CHART SHOWING INHERITANCE OF WEBBED TOES THROUGH FOUR GENERATIONS

The webbed condition has appeared always between the second and third toes of each foot An interesting feature is that the web is always greater in the right foot. Only the male members possess the character. (Fig. 8.)

On the Wrong Track

MOTHERHOOD, by H. W. Long, M.D., neurologist and psychoanalyst. Boston, Richard G. Badger, 1921. Pp. 195.

Dr. Long writes in a frank, wholesome way, and has some sensible remarks on motherhood and preparation for it; but more than half of his book is taken up by a plea for pre-natal influence and maternal impressions as an important instrument of euthenics. He declares, erroneously, that the "gift of mentality seems to violate all known laws of heredity by its irregularities in transmission," and issues the customary cant about the unwillingness of men of science to recognize the world-old experience alleged to show the reality of pre-natal influence. I believe men of science are all ready to accept any real experience on this or any other point; but it will take a great deal more than the puerilities which Dr. Long cites, to get a hearing for maternal impressions from any intelligent adult. If his cases are the strongest that can be adduced, his cause is indeed weak. Take his case C-125 as a fair sample: Mrs. F. and her husband were habitual users of wines and liquors, but during her pregnancy Mrs. F. expressed a desire for brandy. Mr. F. economically secured a cheap and bad whiskey instead, thinking that his wife, who had never tasted brandy, would not know the difference. She took a mouthful and spit it out in disgust, saying she did not like it. "The son who came of this gestation is, and always has been, a teetotaler, and an enthusiastic temperance worker. He cannot understand how or why any one can find pleasure in strong drink." The author states that the Euthenic Society of Peoria (Ill.) is in existence to develop this line of racial betterment.—P. P.

SPECIMENS OF THE TUSCAN PEACH VARIETY WITH THE DEVELOPED LOBE MATURE

Each lobe bore its pistil and developed its own pit. Below shows one lobe of each triplet removed to show the fruit spur split so as to accommodate the lobes and permit of growth and development. (Fig. 9.)

COMPOUND FRUITS IN THE PEACH RESULTING FROM MULTIPLE PISTILS

R. E. KARPER
Texas Agricultural Experiment Station, College Station

A RATHER remarkable case of multiple fruits in the peach occurred in the season of 1919 in the experimental orchard of the Texas Agricultural Experiment Substation located at Lubbock, Texas. This station is located on the Staked Plains at an elevation of 3200 feet. Peaches in this section yield well in years when they escape the spring frosts, but most varieties are usually killed in the bud about three years out of every five.

A crop of peaches was produced in 1919, which was the first full crop since 1915. The seasons of 1917 and 1918 were extremely dry and very little growth was made by the trees. In the fall of 1918 and spring of 1919 good moisture conditions prevailed, inducing a fall growth of fruiting wood, a vigorous condition of the trees and the setting of a superabundance of fruit in the spring.

SEPARATE PISTILS ON SAME FLOWER

Such abnormalities as double or two-lobed peaches resulting from compound pistils occur quite frequently; and even three lobed peaches have been observed. In this case, however, we have many simple pistils rather than a compound pistil, the multiple fruits produced running as high as quintuples and occurring in large numbers.

This phenomenon was first observed soon after the blooming period and before the corolla was shed. Each lobe of the multiple fruit in the same flower arose from a simple pistil and each lobe or member of the multiple developed its own pit. As the fruit developed one or two of the lobes or fruits would generally reach normal development, the others, becoming abortive and making very slow growth, would usually shrivel or dry up and drop, or be forced off the pedicel by the developing lobes. Many doublets and triplets developed normally and produced perfect fruit, but none above triplets developed perfectly mature fruits.

In order to accommodate the multiple fruits the pedicel was often split by the growing fruits or lobes crowded together, each lobe adhering to its portion of the pedicel.

The accompanying data show the percentage of single, double, triple, quadruple, and quintuple fruits borne from the same flower for each of the bearing trees in the orchard, and give an average for the trees of each variety.

The impressive fact of these data is that in some of the varieties the bearing of single or normal fruits is the exception rather than the rule. The interesting point in the case of multiples is that it was not a chance, or isolated occurrence, but rather a general condition existing in a large number of practically all varieties.

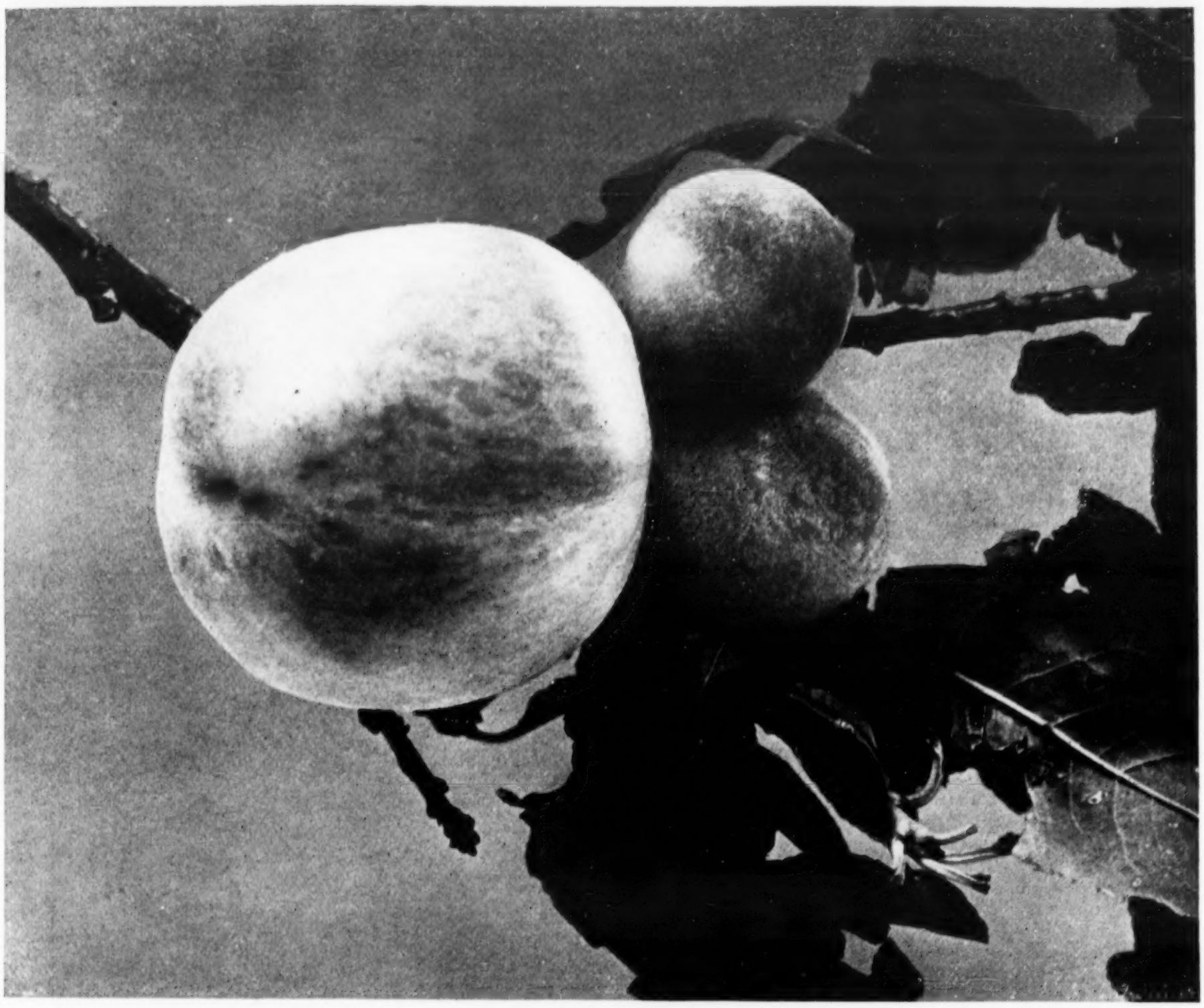
HIGH PER CENT OF MULTIPLE FRUITS

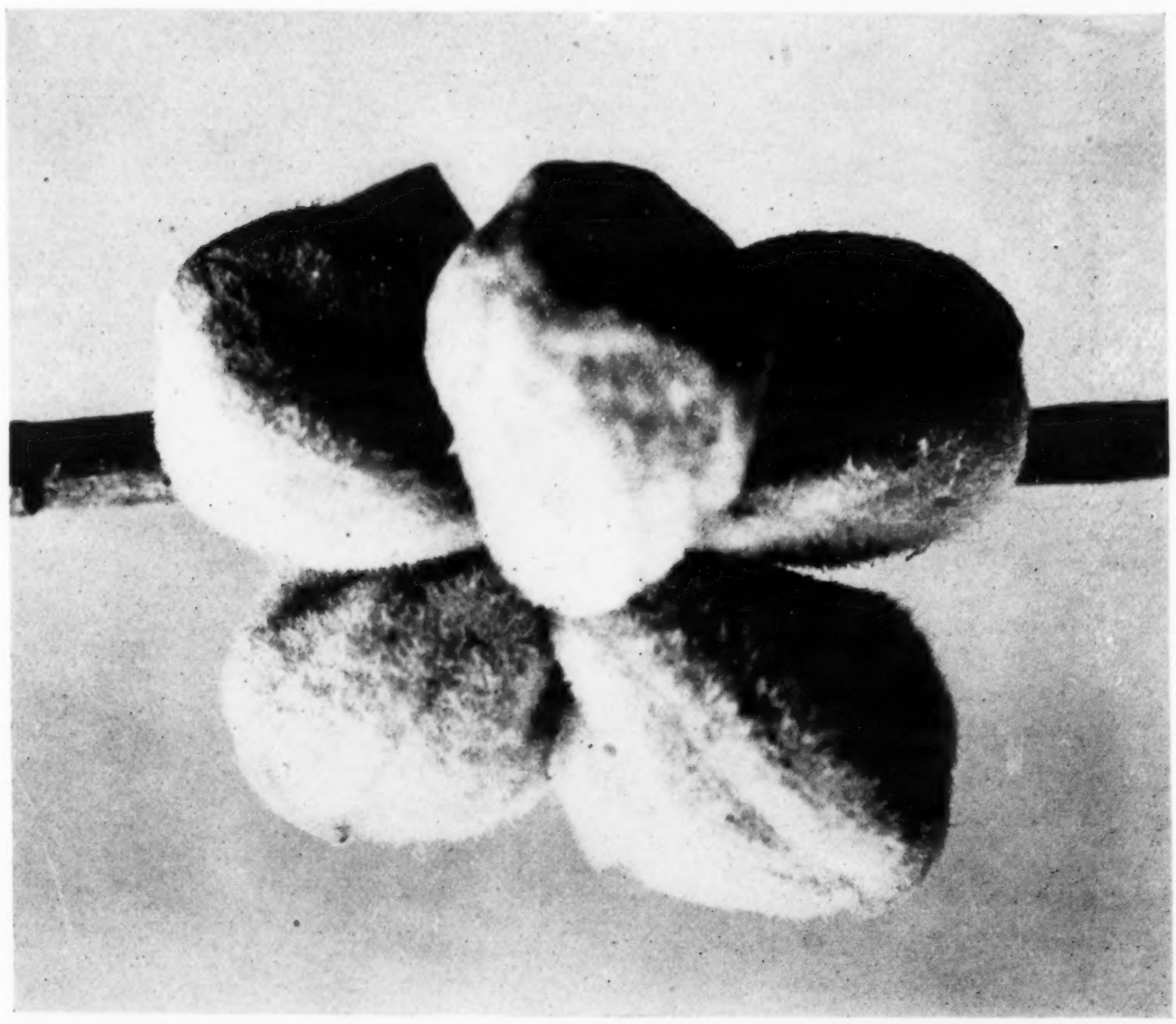
As previously stated, a full crop of peaches had not been produced by this orchard since 1915, but in 1918 the Mayflower, Salway, Alton, Krummel and Japan Blood produced a medium crop of fruit. It will be seen that this year these varieties in every instance bore comparatively few multiple fruits and that the Krummel and Japan blood bore only normal fruits. The Hottes Elberta, which bore a few specimens of fruit in 1918, had a low per cent of multiples. The seedling tree No. 121, which bore a light crop in 1918, produced forty-five per cent of the fruit in 1919 as multiples, but none above triples. With this exception none of the trees which bore the previous year produced any abnormal

Percent of Multiple Fruits Occurring in Different Varieties of Peaches

Tree No.	Variety	Percentage of Fruits				
		Single	Double	Triple	Quadruple	Quintuple
1	Mayflower*	96	4	0	0	0
2	Mayflower	87	13	0	0	0
3	Mayflower	94	6	0	0	0
4	Mayflower	89	11	0	0	0
5	Mayflower	89	11	0	0	0
	Average	91	9	0	0	0
6	Susquehanna	27	58	14	0	1
7	Susquehanna	19	61	17	3	0
8	Susquehanna	11	48	36	5	0
9	Susquehanna	14	64	20	2	0
	Average	17.75	57.75	21.75	2.5	.25
10	Hottes Elberta*	100	0	0	0	0
115	Hottes Elberta	98	2	0	0	0
117	Hottes Elberta	97	3	0	0	0
	Average	98.33	1.66	0	0	0
11	Foster*	50	41	7	2	0
12	Foster	8	81	11	0	0
13	Foster	5	81	12	2	0
14	Foster	39	60	1	0	0
153	Foster	42	55	3	0	0
	Average	28.8	63.6	6.8	.8	0
15	Tuscan*	82	18	0	0	0
17	Tuscan	3	44	40	12	1
18	Tuscan	12	42	41	4	1
154	Tuscan	25	58	16	1	0
	Average	30.5	40.5	24.25	4.25	.5
19	Orange Cling	7	44	40	9	0
20	Orange Cling	4	31	43	18	4
21	Orange Cling	2	41	44	13	0
22	Orange Cling	8	23	51	18	0
23	Orange Cling	19	31	30	17	3
	Average	8	34	41.6	15	1.4
118	Alton	75	25	0	0	0
119	Alton	96	4	0	0	0
120	Alton	91	9	0	0	0
	Average	87.33	12.66	0	0	0
124	Japan Dwarf Blood	100	0	0	0	0
125	Japan Dwarf Blood	100	0	0	0	0
126	Japan Dwarf Blood	100	0	0	0	0
24	Salway*	99	1	0	0	0
113	Captain Ede	2	68	29	1	0
114	Hiley*	92	8	0	0	0
121	Seedling	55	43	2	0	0
122	October Elberta	8	31	46	14	1
123	Krummel	100	0	0	0	0

*Trees infested with crown gall.





A TRIPLE FRUIT OF THE FOSTER VARIETY

(above)

As the fruit developed, usually one or two of the lobes would develop normally, the others being abortive and dropping or being forced off the pedicel by the developing lobes. (Fig. 10.)

A FIVE-LOBED ABNORMALITY

(below)

This five-lobed abnormality in the peach resulted from the fertilization of five pistils in the same flower and contained five pits. Normal development ceased about mid-season. (Fig. 11.)

fruits above doubles. The remainder of the trees represented in the table produced their last crop in 1915. In all of these varieties the per cent of multiple fruits is high, with Orange Cling and October Elberta the highest, having ninety-two per cent abnormalities ranging from twins to quintuples.

The trees infested with crown gall were naturally of lower vitality and in less vigorous condition, and produced quite generally a lower per cent of multiple fruits. On the other hand, the most vigorous trees and those with the heaviest set of fruit had the highest per cent of multiples.

CAUSES OF ABNORMAL PRODUCTION

In view of the data available it appears that this abnormal condition was brought about by environmental influences causing disturbance in the reproductive organs of the peach. The severe climatic conditions and lack of moisture in the soil resulted in a dormant and unproductive state on the part of the trees lasting for several years, and upon the return of favorable conditions the sudden vigor stimulated them to unusual functioning which gave rise to a tendency to overproduction. The trees have produced normal fruit in previous years, and will, undoubtedly, do so in the future unless affected by similar external influences. The proper combination of environmental factors which brought about this phenomenon may not soon occur again, yet this case proved the deep-seated influence of such factors even on the morphology of the reproductive organs in the peach.

HERITABLE CHARACTERS OF MAIZE

X. ZEBRA STRIPED LEAVES[1]

M. DEMEREC

N. Y. State College of Agriculture, Ithaca, N. Y.

ZEBRA striped leaves of corn were first observed in the summer of 1920 by Professor Emerson in two F_3 generation families resulting from a cross between Eight-row sweet corn and a small pop corn that had been produced by a cross of California Rice with Tom Thumb pop. The material was turned over to the writer for further study. In the summer of 1921 it was noted that among the corn grown for genetical studies some other families, distantly if at all related to the foregoing, were also segregating for zebra striping. This is an indication that the character had probably been present in the material for some time, but had not been noticed before. In the same summer apparently the same type of striping was found in the progeny from three selfed plants. The seed for one of these plants was obtained during the previous year from the Breck Seed Company of Boston. It was a yellow dent corn, Minnesota, No. 13. The seed for the two other plants was obtained from the Vermont Experiment Station. One sample was marked Freak No. 4 and the other Freak No. 5 on account of the peculiar shape of the ears. Intercrosses were made to find out if those apparently like characters were genetically identical, but these tests have not been completed.

DESCRIPTION OF ZEBRA STRIPING

Zebra striping does not show in the early seedling stage. It belongs to the group of chlorophyll characters in which the normal amount of chlorophyll diminishes with the age of the plant.

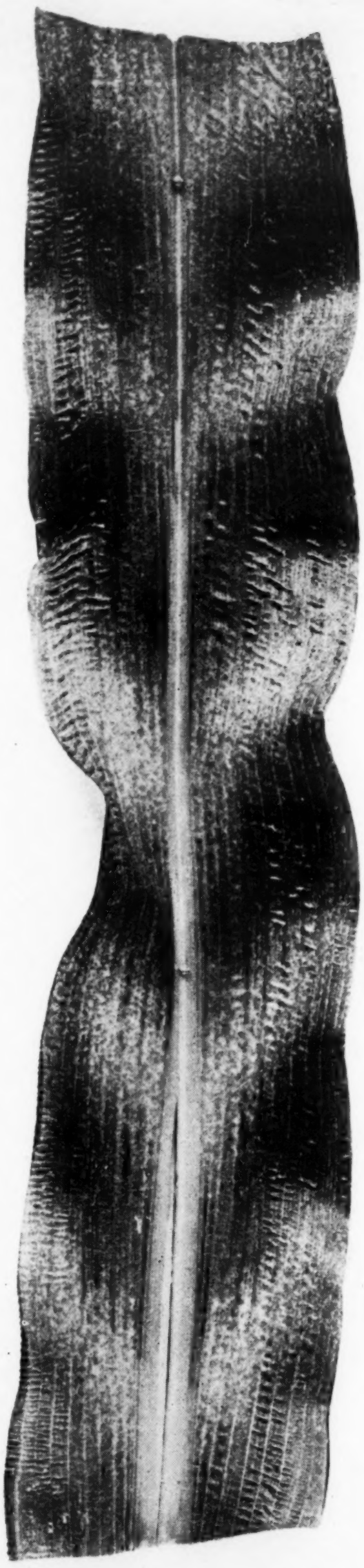
[1] Paper No. 98, Department of Plant Breeding, Cornell University, Ithaca, N. Y.

When the seedlings are old enough, minute yellowish green dots appear as a result of the disappearance of chlorophyll. These dots are numerous and arranged close together forming regular transverse stripes. Later the dots enlarge in size and become more or less continuous yellowish streaks, the shape and size of which can be seen in Fig. 12. Zebra striped leaves are wavy probably because of unequal growth of the green and the chlorotic tissues.

Zebra striping is a distinct mature plant character. It is not very prominent in some cases, due perhaps to some modifying factor, but is always sufficiently developed so that it can be detected by careful examination. In the spring, I was able to distinguish the striping on 4-5 weeks old seedlings, but in the late fall this was not possible on still older seedlings. It is probable that a relatively strong light is necessary for the development of zebra striping.

INHERITANCE OF ZEBRA STRIPING

Zebra striping is an inherited character. Selfed zebra plants give zebra progeny only. Green plants crossed with zebra give in the F_1 generation green plants only. Plants heterozygous for zebra crossed with homozygous zebra gave 178 green and 152 zebra plants, which is fairly close to a 1:1 ratio. From this it might be concluded that zebra is a simple mendelian recessive. The data obtained from the F_2 generation, however, show in some cases a very low percentage of zebra plants. Six F_2 families had a total of 115 green and 20 zebra striped plants. Four of these families, however, had 92 green and seven zebra plants, which is very nearly a 15:1 ratio. One family, on the contrary, had only 17 green to 11 zebra striped plants. Some of Professor Hutchison's pedigrees also, which are not closely if at all related to the material used in this study, segregated for zebra striping. He found 307 green and 107 zebra plants, practically in 3:1 ratio. At this time the genetical tests are not complete enough for final factorial analysis. The only conclusion that can be drawn is that zebra striping is a mendelian character and that it is recessive to green.

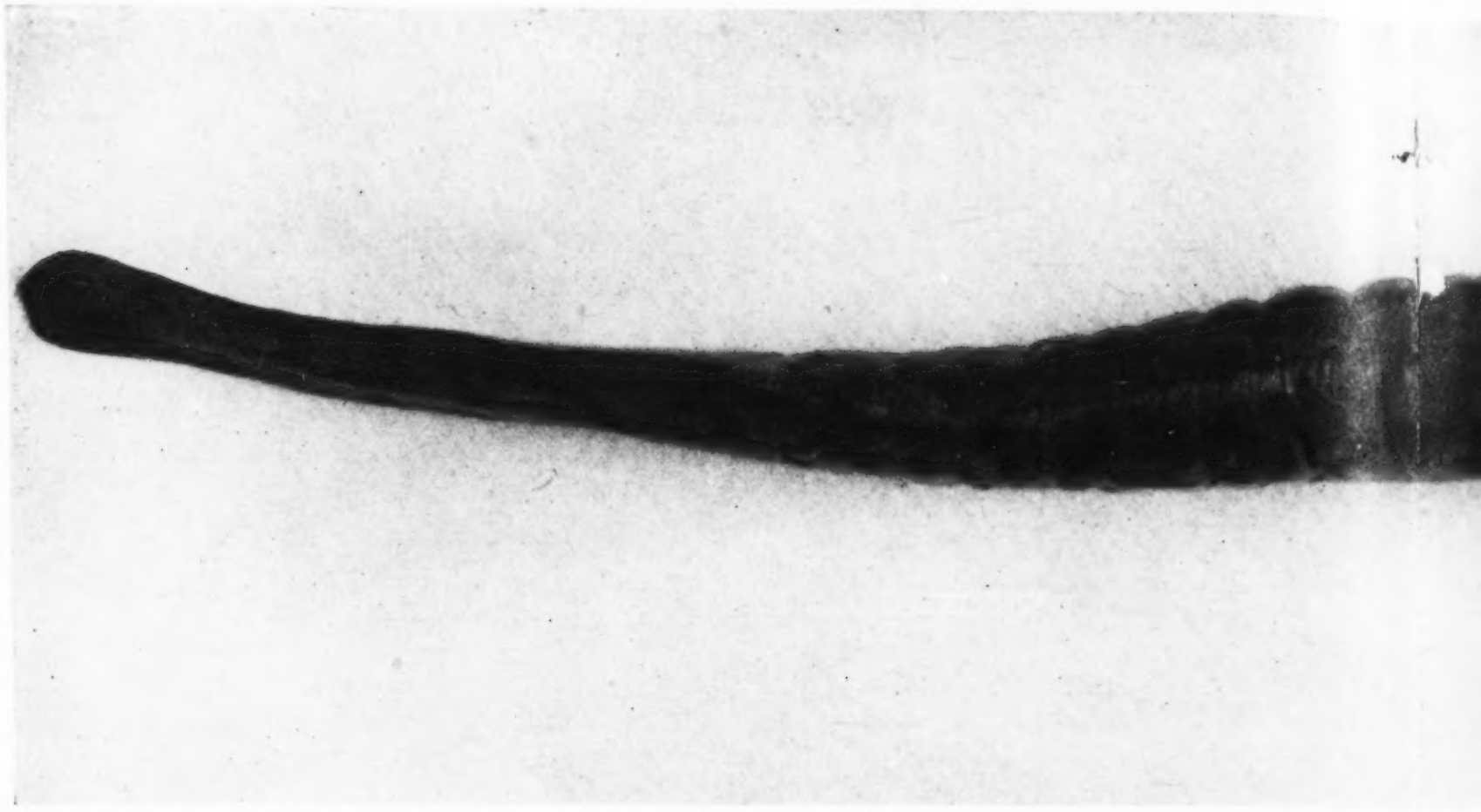


ZEBRA STRIPED LEAF

Transverse stripes made up of numerous yellowish dots appear on the leaves of corn in the young plant stage and become more pronounced in later stages of development by the enlargement and coalescence of these dots. (Fig. 12.)

EXPERIMENTAL GIGANTI

E. UHLENHUTH, *Rockefeller Institute for*



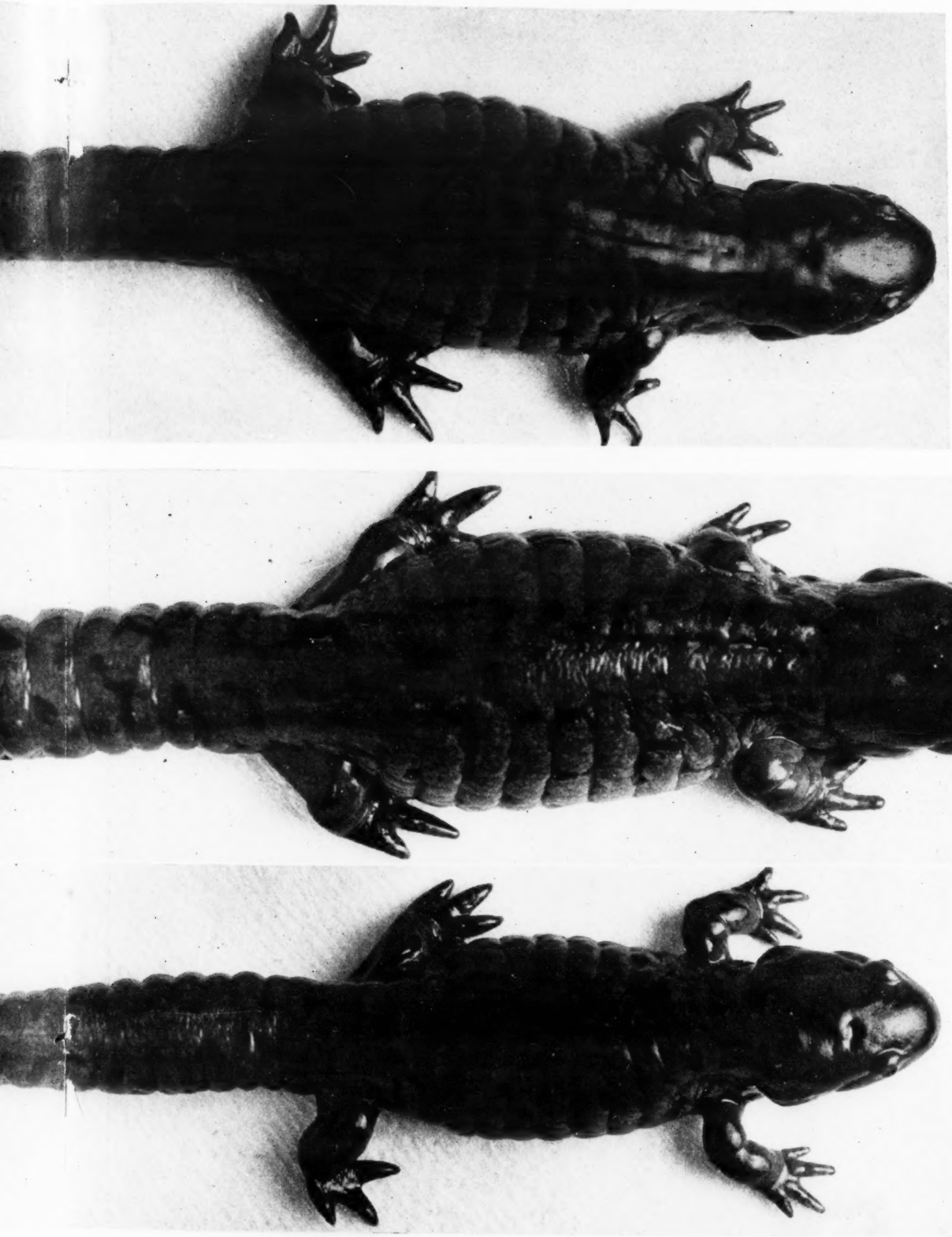
Natural size photographs of salamanders showing effect of diet upon growth. The top animal was fed beef liver, the middle one anterior lobe and the bottom one earthworms.

Although certain facts, such as the considerable enlargement of the anterior lobe of the hypophysis in human gigantism and in acromegaly, have made it almost certain that the pituitary body plays some important rôle in the phenomena of overgrowth and in growth in general, it has not been possible to produce gigantism in animals by feeding anterior lobe. So far, in the experiments of feeding pituitary only warm-blooded animals have been employed. If, however, anterior lobe of the hypophysis is fed to the cold-blooded salamander, *Ambystoma tigrinum*, a considerable overgrowth is secured.

This fact is illustrated by the accompanying figure, which shows three male salamanders of the same brood and age, taken from a large number of feeding experiments performed on this species of animals during the last three years and giving essentially the same results. A different food material was fed to each of these three animals, each one representing the largest individual of a group of similarly fed animals. The middle animal was fed anterior lobe of hypophysis, the bottom one a normal diet (earthworms) and the top one beef liver. It will be seen at the first glance that the anterior lobe-fed animal is, by far, the largest one; its

ANTISM IN SALAMANDERS

Institute for Medical Research, New York City



weight exceeds by 96 per cent that of the normal worm-fed control animal. The liver-fed animal is larger than the control animal, but much smaller than the anterior lobe-fed animal.

Although liver-fed animals grow larger than worm-fed animals, neither liver nor earthworms permit the salamanders to become as large as the hypophysis-fed animals. It is noteworthy that the hypophysis-fed animals exceed in size not only the controls, but are considerably larger than any known normal individual of that species. (Fig. 13.)

MENDELISM IN FUR SHEEP CROSSES

RUSSELL W. DUCK
Department of Animal Husbandry, Syracuse University

SOME interesting results have been obtained from crossing Karakul rams on long-wool and Cheviot ewes. Work along this line by F. E. Dawley, of Fayetteville, N. Y., shows the complete dominance of Karakul fleece, provided the Karakul cross is homozygous, for the color and fur bearing factor. The work also shows the practical value of a knowledge of Mendel's first law.

Karakul lambs at birth are black in color with an occasional white spot on the head or tail, the ringlets of fur should be of a bright luster and tight curl. Density, curl, luster, pattern and color are the factors which determine merit in a Karakul skin, known commercially as Persian Lamb. The beauty of pattern formed by the irregular arrangement of the curls, and the fineness and softness of the coat add much to its value. The desired condition of the skin of the lamb soon disappears as it grows older. When only twenty-four to forty-eight hours old the curls begin to loosen, and the fleece increases in length; as the lamb nears six months of age the fleece gradually changes to dark gray wool, very long and open in character.

Davenport found black wool recessive to white in sheep. He has shown that black crossed on black gives only black, and that black outcropping in white sheep is simple recessive segregation. But, in the Karakul cross on white wool, the white wool factor behaves quite differently, it is unmistakably recessive to black.

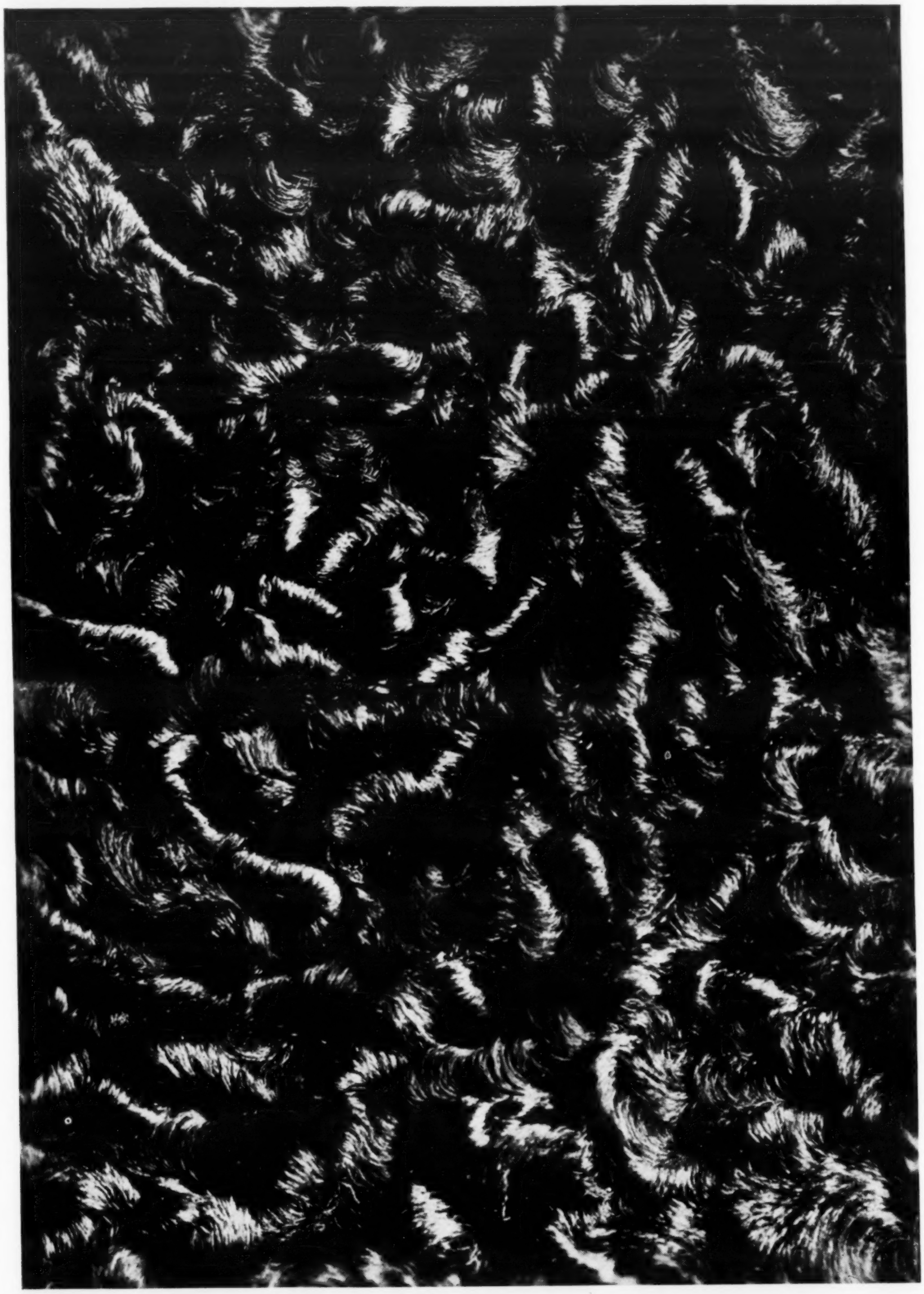
In 1912 Mr. Dawley made some crosses to determine the inheritance of coat color and fur bearing qualities of Karakuls when crossed on other breeds. Two large type Karakul rams, forty Lincoln, twenty Leicester, twelve Cheviot, ten Black Faced Highland and ten Cotswold ewes were used in the first cross. The same ewes were bred to the same rams again in 1913. The table at the bottom of this page shows the results obtained.

Out of ninety-two ewes and two years' lamb crop all the lambs except two were black. One red lamb was dropped in 1912 by a Leicester ewe and another was yeaned in 1913 by a Lincoln ewe. The production of an occasional red is apparently not associated with any particular breed, and might be explained by the introduction of an extension factor, which is of infrequent occurrence. The dominance of black color was duplicated by three other characters, curl, density and luster, which proved dominant to straight, long, dull wool. The skins of the F_1 lambs were decidedly of the fur type. From the illustration it will be noted that the skin from an F_1 lamb was curled and lustrous, closely approaching the desired Karakul type (Persian Lamb).

In 1914 and 1915 the F_1, black ewes from the first cross were bred back to an imported Karakul ram

Karakul Rams Crossed with Other Breeds.

PARENT			OFFSPRING				
				1912		1913	
Sire	No.	Ewes	No.	Black	Not Black	Black	Not Black
Karakul	2	Lincoln	40	42	None	45	1 red
"	2	Leicester	20	22	1 red	23	None
"	2	Cheviot	12	18	None	16	None
"	2	Bl. Faced Hi.	10	12	None	14	None
"	2	Cotswold	10	12	None	13	None



SKIN FROM FIRST GENERATION CROSS—KARAKUL RAM BY LIN COLN EWE

Experiments in crossing Karakul rams on long-wool and Cheviot ewes have brought some interesting results in color and fur bearing factors. The Karakul skin is characterized by dense, lustrous ringlets of fur, the density and luster becoming less as the animal grows older. The skin shown in the photograph is from a first generation crossbred between a homozygous Karakul ram and a registered Lincoln ewe. It shows the dominance of black color, and also proved that the other characters of curl, density, and luster were dominant to straight, long, dull wool. (Fig. 14.)

IMPORTED ABOU BEN ADAM HOMOZYGOUS RAM

This ram, eleven years old at time of photograph, was used to produce the first generation cross in the experiments to determine the inheritance of coat color and fur bearing qualities of Karakul sheep when crossed with other breeds. "Out of ninety-two ewes and two years' lamb crop all the lambs except two were black." (Fig. 15.)

named Pultava. The table on page 413 shows the results obtained from this back cross.

The ewe lambs yeaned in 1913 were not bred back until 1915 so that more individuals were used in the 1915 back cross than in 1914. The results show an apparent contradiction to the first cross; however, such is not really the case. With our present knowledge of Mendelism, these characters are ap-apparently simple allelomorphs, and therefore prove that the Pultava ram was heterozygous (mixed) for both the color and fur factors. His blood has since been discarded in the Dawley flock. The selection and breeding of fur sheep in their native country is not always done as carefully as the American breeder could desire. Outcrosses have, no doubt, been used which would result in a heterozygous individual for both the color and fur factor. Flock books are not maintained and records are imperfectly kept at best. This accounts for the apparent contradiction in the second cross. The results of later crossing proved this conclusion of the mixed character of the Pultava ram.

In 1916, '17, '18, and '19 black ewes were selected which showed desirable curl, density and luster, they were mated to Karakul rams of supposed

pure strain. Any ram that threw off-colored or off-type lambs was discarded. In the 1920 cross all the lambs thus produced were black in color and the fur, without exception, could not be distinguished from that produced by imported Karakul ewes or their offspring.

Therefore, so long as the breeder is dealing only with allelomorphic characters which follow Mendel's first law of dominance, recessiveness and segregation it is quite easy with a knowledge of these basic principles to produce maximum results in minimum time.

In a later article the Mendelian principles underlying the appearance of an occasional red lamb will be offered.

Heterozygous Karakul Ewe Lambs Crossed on "Supposed" Homozygous Karakul Sire

Parent		Offspring					
Sire	Ewes	No.	Black	Spotted	Red	White	Year
Pultava	F. 1	56	41	6	5	11	1914
"	F. 1	100	80	9	8	14	1915
Total		156	121	15	13	25	
Expected		156	172	None	1 or 2	None	

Evolution and Social Progress, by Joseph Husslein, S.J., Ph.D. Pp. 287. New York, P. J. Kenedy & Sons, 1920.

Dr. Husslein vehemently assails "materialistic evolution," which he says is the doctrine commonly taught, and which he believes to imply atheism, and to be subversive of morality. He accepts "scientific evolution," which he says is all of the evolutionary doctrine that is supported by actual facts, as distinguished from the speculations and hypotheses that pass for facts with the materialistic philosophers. The doctrine of evolution as thus qualified seems to include (1) belief in the existence of God as Creator; (2) acceptance of the evolution of the inorganic world along the lines of the nebular hypothesis; (3) belief in the creation of an indefinite number of low types of plants and animals, with evolution of other forms from these original creations; (4) adherence to the idea that man was specially created, perhaps not more than 10,000 years ago, and is not a descendant of a lower or more generalized type of animal; (5) supposition that religion, morality, social organization, etc., are the products of Divine revelation rather than of evolution as generally understood. Several chapters are devoted to an attempt to show that the first chapter of Genesis, properly interpreted, is in accord with the best modern scientific knowledge: "either Moses knew as much about science as we, or else he was inspired." It is difficult to review adequately, in a scientific journal, a volume which is written from a point of view so radically different from that of the world of science. Dr. Husslein's book takes one back to the period of Haeckel, Huxley, Bishop Wilberforce and the Duke of Argyll; but it marks some advance, at least, in the attitude of the extreme exponents of dogmatic theology. The author makes the most of the inconsistencies and differences of opinion of the biological world, but he is not likely to be convincing except to those who want confirmation of their existing convictions.—P. P.

Former Numbers of the Journal Wanted

The office of the Journal desires copies of some previous issues of this Journal as its supply is exhausted. If any member will dispose of the following, please communicate with the managing editor: January, February, March, and April 1914; October 1918; January, February, and April 1920.

INFLUENCE OF THE THYROID GLAND AND HYPOPHYSIS UPON GROWTH AND DIFFERENTIATION

BENNETT M. ALLEN
Department of Zoology, University of Kansas

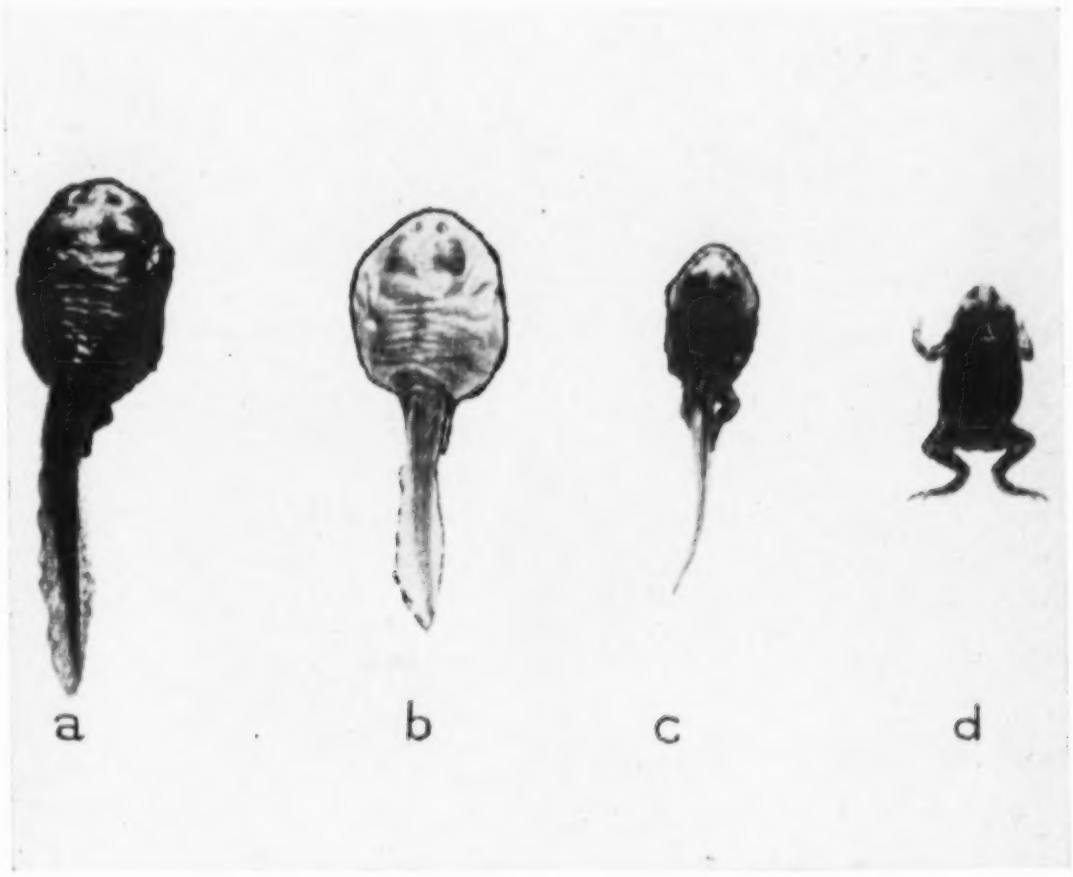
RECENT years have witnessed spectacular advances in our knowledge of the endocrine or ductless glands. This field was a terra incognita thirty years or more ago, but today it is a field of enchanting possibilities. The thyroid gland and the hypophysis, with which this paper deals, exert a profound influence upon growth and differentiation, not only among the amphibians upon which our experiments have been performed, but likewise in man as we are learning from a study of dwarfs and giants.

While clinical evidence is of very great importance in bringing us close to the practical problems of medicine, we are here dealing with the influence that these glands exert as a result of disease, and we must constantly keep in mind the fact that the conditions observed are pathological, that the endocrine glands are in these cases functioning in abnormal ways. With experiments upon mammals we meet the difficulty that these glands can be removed only after birth, while as a matter of fact, the embryo undergoes the most important part of its development before birth. Definite direction is already given to some of the most important features of growth and differentiation of mammals long before we can hope to operate upon them. We have no intention of belittling the very significant pioneer work, such as Hoffmeister and others, practiced in the removal of the thyroid glands of dogs and sheep. Such work has its great value but it does not give a wholly pure result. We are not in these cases dealing with animals that never have been under the influence of these glands. While these various methods of experimentation have their value, we can get a "chemically pure" reaction only when we may remove these glands at their inception when we extirpate their anlagen. By far the most favorable opportunity for work of this kind is afforded by experiments upon amphibian larvae, which develop from eggs fertilized outside the body of the parent. The tadpoles are peculiarly resistant to the most severe operations, showing a marvellous capacity for healing wounds and there is an unusual degree of resistance to infection. The process of differentiation is marked by the spectacular metamorphosis of the tadpole into the frog. These favorable features make it possible for us to remove these glands with success and to observe the effects most clearly.

We may also attack these problems from a different angle—by adding these glandular secretions instead of eliminating them. This may be done in three ways: (1) by feeding, (2) by hypodermic injection, and (3) by implantation. By a combination of processes of gland removal and addition of extracts and living tissue, we may at will create in our tadpoles almost any desired combination of endocrine glands. We may remove and reinstate at pleasure. The thyroid gland was fed to tadpoles by Gudernatsch in his pioneer investigations. This experiment many times repeated by others results in precocious metamorphosis—a process that affects the organism as a whole, not only involving the development of the limbs, tongue, mouth, brain, and other internal structures, but bringing about the shortening of the intestine and disappearance of the tail as well.

A complete reciprocal of this experiment is found in the removal of the thyroid gland. This experiment was performed simultaneously by Allen and

Hoskins. The results are most interesting. Development proceeds quite normally for two months or more, up to the time of appearance of the hind limbs. In every regard, both of size-growth and differentiation, the thyroidless specimens resemble the normal controls up to this period. In normal tadpoles there is before this time no accumulation of colloid secretion in the thyroid gland. This period—the beginning of metamorphosis—is the stage at which the thyroid glands begin to differentiate and to actively function. In normal development metamorphosis follows as a direct result of this development and functional activity of the thyroid gland, while in the specimens from which this gland has been removed there is an almost complete cessation of metamorphosis. The tadpoles grow to gigantic size and they have been reared to an age of three years but the hind limbs remain very small and in no case of complete thyroid removal do the fore limbs break through the skin. It is a significant fact that the tadpoles of the common toad Bufo lentiginosus reach a more advanced stage of development when deprived of the thyroid gland than do the tadpoles of the leopard frog Rana pipiens. It seems clear that various other factors carry development up to a certain point beyond which it can not proceed under normal conditions without the functioning of the thyroid gland. The degree to which thyroidless tadpoles may develop differs in different amphibians.



BUFO (TOAD) TADPOLES AND RECENTLY METAMORPHOSED TOAD. NATURAL SIZE

(a) A thyroidless tadpole six months after normal time of metamorphosis. (b) A pituitaryless tadpole six months after normal time of metamorphosis. (c) A normal tadpole in limb development of corresponding degree to that in a and b. (d) A normal toad immediately after metamorphosis. (Fig. 16.)

A careful study of these tadpoles thus retarded in development shows that, so far as we can see, the retardation affects not only the superficial features of limb-growth and tail-shrinkage, but that it also applies to all of the internal structures as pro-nephros, pancreas, liver, alimentary tract, thymus gland and even the process of ossification. The brain not only appears to retain its larval condition when viewed externally; but microscopic sections demonstrate this fact most clearly. This is especially suggestive in view of the well known fact that cretins are so often sub-normal mentally. All of these features seem chained in their embryonic conditions. In striking contrast to these somatic features we find that the germ glands and germ cells continue in their development. Not only do they grow in size, but they continue to differentiate, ripe sperm developing in the testis of Rana pipiens larvae prevented from metamorphosing by thyroid removal. This is evident some four or five months after the time of normal metamorphosis. In the normal controls spermatogenesis does not occur until about this length of time after metamorphosis. While oocytes have not become mature in these thyroidless tadpoles, they have at least undergone increase in size far beyond that reached at the time of normal metamorphosis. It thus seems clear that there is a radical difference between the somatic structures and the germ glands. The

development of the former is controlled by the thyroid gland while the gonads develop independently of it. We should not at this time lay too great emphasis upon this point, but it is at least suggestive. If substantiated by further investigations, such a radical difference between soma and germ cells would be most significant in view of the theories of heredity that are based upon the assumption that the germ-cells are not influenced by changes in the soma.

It has been long known that iodine is the most characteristic chemical constituent of the thyroid secretion; it is therefore interesting to find that by feeding iodine, Swingle produced the same effects of metamorphosis in tadpoles that are produced by feeding thyroid preparations. We are thus led to the conclusion that the iodine accumulated by the thyroid gland is the active agent in the acceleration development. Kendall's interesting work in the analysis of the thyroid secretion should be taken into account. He has isolated the substance thyroxin, the constituent richest in iodine and considers this compound to be the active agent involved. It remains to be seen whether the simple iodine element alone can accelerate development in forms other than the amphibians. There is no question about its potency in that group. Swingle was even able to show that tadpoles deprived of the thyroid gland can be made to transform when fed iodine.

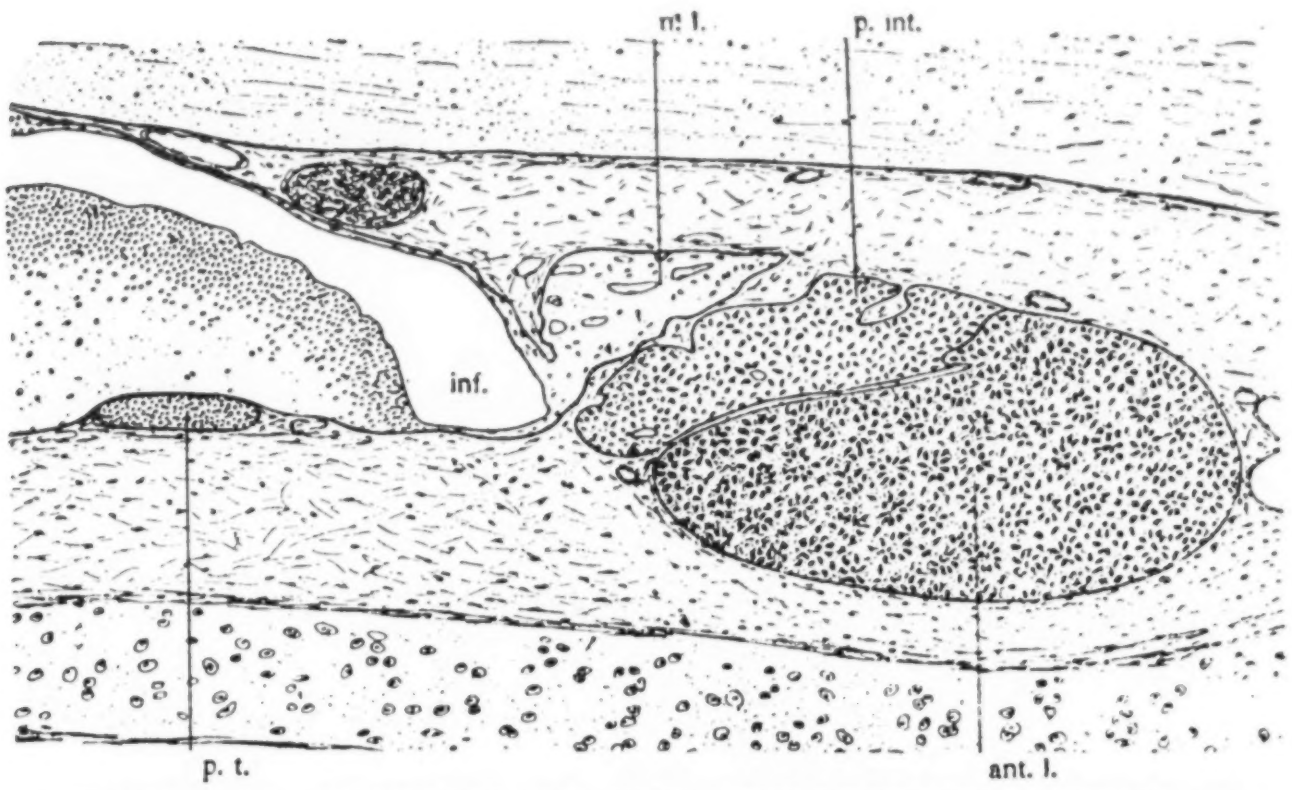
THYROID FEEDING CAUSES SHRINKAGE

While the thyroid gland has a marked influence upon the process of differentiation, it appears to regulate size growth secondarily through its influence upon the attainment of maturity. Feeding or implantation of the thyroid gland brings about a distinct shrinkage of tadpoles so treated. This has been by some described as a "burning up" process due to greatly accelerated metabolism. This might prove true but we should be cautious and demand proof upon this point. It is well known that the tissues of amphibians, especially in the larval stage contain an enormous percentage of water. Only careful weighing of dried specimens can serve to determine whether thyroid or iodine feeding does or does not cause an actual wasting of the essential substance. Students in this laboratory are now working upon this question and upon the relation of the thyroid glands to the fat bodies—a nearly allied problem. Certain it is that thyroid feeding causes shrinkage rather than size growth.

THE HYPOPHYSIS

The hypophysis, often called the pituitary gland, is really made up of four parts physiologically quite different from one another, at least this is true of the three portions whose functions we are beginning to understand. Three of the four portions arise from a cord of cells that grows inward from the surface layer of the body and comes to lie under the brain. It develops into anterior lobe, intermediate lobe and lateral lobes (pars tuberalis). A fourth portion develops from the tip of the infundibulum of the brain with which the hypophysis comes in contact. These portions are shown in the figure. It is possible to remove the entire cord of cells from which all but the posterior lobe develop. The latter develops in the absence of these portions; but Smith claims that it does not attain normal growth.

With the removal of the anlage of these lobes (anterior, intermediate, and pars tuberalis portions) certain striking effects are produced, as follows: (1) Prevention of metamorphosis at the same stage attained in the absence of the thyroid gland. (2) Retardation of growth in size. (3) A most striking color change from the normal black to white, due to the contraction of black pigment cells and an expansion of certain silvery white cells, the xantholeucophores. (4) Apparently heightened mortality evident only several weeks after the operation. This was first accomplished by Adler by rather imperfect technique. Later Allen and Smith independently devised a much better operation for removal. The writer has made a partial analysis of these functions by implanting separately the anterior lobe,



A SAGITTAL SECTION OF THE HYPOPHYSIS (PITUITARY GLAND) OF THE FROG

Ant. l—Anterior lobe. p. int.—Intermediate lobe. n.l.—Posterior lobe (neural lobe). p.t.—Lateral lobe (pars tuberalis). (Fig. 17.) Illustration from *The Anatomical Record* Vol. XV, No. 2, Sept. 1918.

the intermediate lobe and the posterior into specimens from which the three lobes mentioned were extirpated. These tissues thus transplanted were taken from adult frogs and transferred to a pocket under the skin above one eye of the tadpole at some distance from the normal position. The results are most striking. The transplantation of the anterior lobe brings about an initial increase in size and a strong tendency toward metamorphosis. Complete transformation has not been produced in this manner but there has been a close approach toward it. This lobe has no influence upon the color change, but the restoration of the intermediate lobe into the white pituitaryless specimens causes a resumption of the normal black color. The influence of the anterior lobe of the hypophysis upon metamorphosis—growing mature—is closely linked with the thyroid gland. In tadpoles from which the hypophysis has been removed, the thyroid gland is very poorly developed. A few follicles are formed with very small masses of colloid secretion. Evidently the thyroid gland remains inactive in the absence of the anterior lobe of the hypophysis, the two being most intimately associated in physiological activity. It was stated above that the transplantation of the anterior lobe of a frog hypophysis into one of these tadpoles deprived of its hypophysis causes a resumption of development. It is most significant that this accompanies a marked increase in the size of the thyroid gland and of its contained colloid secretion. The restoration of the anterior lobe of the hypophysis thus causes a resumption of the growth and functional activity of the thyroid, and the tadpole proceeds on its way toward metamorphosis.

Smith has shown that feeding the anterior lobe of beef hypophysis to tadpoles of Rana boyeli from which the hypophysis had been removed, causes them to resume their normal rate of size growth that had been inhibited by its absence. Hoskins claimed that the feeding of commercial hypophysis preparations also produces metamorphosis, but Smith has shown that this is not the case where he himself secured and prepared his material. Hoskins had analyzed the commercial preparation that he used and demonstrated a small quantity of iodine which he considered too little to produce an effect. The presence of this iodine was probably due to contamination and the amount was, contrary to Hoskins' judgment, sufficient to produce the metamorphosis that he observed. The writer also produced partial transformation with commercial preparations in unpublished experiments performed five years ago, but hesitated to publish the result because of doubt regarding the purity of the preparation. We are thus forced to conclude that the feeding of laboratory prepared anterior lobe of the hypophysis, free from iodine or possible thyroid contamination, does not bring

about metamorphosis, although it does produce growth in size.

There is a most important difference between the influence of the active implanted anterior lobe of the hypophysis on the one hand and on the other the effects of feeding this gland. In the case of implantation, metamorphosis is furthered through the cooperation or intermediation of the thyroid gland. This is evidenced by the effect of such implantation upon the thyroid gland as explained above, and by experiments performed by the writer in which it was shown that implantation of the anterior lobe of the hypophysis of an adult frog into tadpoles from which the thyroid gland has been removed does not produce any tendency to metamorphosis even though the implant is preserved in normal condition. On the other hand its implantation into normal tadpoles hastens their metamorphosis and its implantation into specimens from which the hypophysis has been removed brings about their transformation, this being always accompanied by increase in the size of the thyroid gland. Keeping these facts in mind and remembering that extirpation of the anterior lobe of the hypophysis prevents metamorphosis, allowing development to proceed only to the point attained in thyroidless tadpoles, we may conclude that there is an intimate functional correlation between these glands and that their co-operation is essential to metamorphosis, unless abnormal amounts of iodine are administered.

A sharp distinction must be made on the one hand between development toward maturity regulated by the functional co-operation of the thyroid gland and the anterior lobe of the hypophysis, and on the other hand the very distinct feature of size growth. This size growth appears to be accelerated by the action of the anterior lobe of the hypophysis alone and is produced by substances-hormones stored up in the gland and active even in dried preparations.

In this connection it is most significant that feeding of dried thyroid glands to tadpoles causes metamorphosis, not only in normal and thyroidless tadpoles, but also in tadpoles deprived of the hypophysis and also in those deprived both of hypophysis and thyroid gland. There is evidence to show that such thyroid feeding does not operate so rapidly toward bringing about a shrinkage of the tail in tadpoles deprived of the hypophysis as it does in those that retain it in a functional condition; but this demands more accurate analysis.

It was pointed out above that Swingle accelerated metamorphosis in normal tadpoles by feeding iodine and that he produced it even in tadpoles deprived of the thyroid gland. Allen showed that iodine feeding would produce metamorphosis in tadpoles from which the hypophysis had been removed and also in those from which both hypophysis and thyroid gland had been removed.

We may from these facts conclude that the process of metamorphosis (growing mature) or these anuran larvae can only take place under normal conditions in nature by the cooperation of the thyroid gland and the anterior lobe of the hypophysis, and that the hormone thus formed is stored in the thyroid gland. It is certain that the most active chemical element in this hormone is iodine and it is probable that the colloid secretion that contains this hormone is in the main active in proportion to the amount of iodine that it contains. We can not say more at present. The functioning of these glands enables vertebrates to segregate the minute traces of iodine that occur in their food and water and to utilize it in furthering development (metamorphosis in the amphibians). In the absence of either or both of these glands it is necessary to administer relatively enormous quantities of iodine in order to accomplish the results normally attained through their agency with the scarcely demonstrable traces of iodine as it occurs in nature.

A BASIS FOR INTERPRETING HUMAN PROBLEMS

These experiments upon amphibian

larvae appear to show that the thyroid gland and hypophysis act in a broad general way upon growth and differentiation of the soma rather than in specific fashion upon certain parts. Studies upon these growth processes in amphibians have an interest to us because of their bearing upon human problems; they furnish a basis for a proper interpretation of important pathological conditions in man. While the study of clinical data has its important medical interest, we must expect to find that the conditions produced by disease of these glands are much harder to analyze than are the results reached by experimentation.

ABNORMAL DEVELOPMENT—OR GIGANTISM

We are familiar with the explanations usually offered to account for gigantism. Marie pointed out in 1886 that this condition of abnormal height is usually the result of enlargement of the hypophysis (pituitary gland) during early life. Frequently this enlargement is due to tumor formation often the result of fracture of the skull in the pituitary region. This early increase in size at first leads to heightened function, but as the disease progresses it usually brings about an under production of secretion leading to lethargy and early death. This disease of the pituitary gland produces abnormal growth of the nose, lower jaw and feet, and it causes the fingers to assume a peculiar spatulate form and to undergo a certain degree of pigmentation. If this enlargement of the pituitary gland takes place after the attainment of maturity, the extreme growth in height can not result because the cartilage plates joining the ends of the bones to the main central portion have been ossified. This late development of these symptoms without giant growth is termed acromegaly. It has been pretty well demonstrated that these conditions result from abnormal development of the anterior lobe of the hypophysis (pituitary gland). And the sharply defined experiments upon tadpoles as outlined above give very definite support to this view.

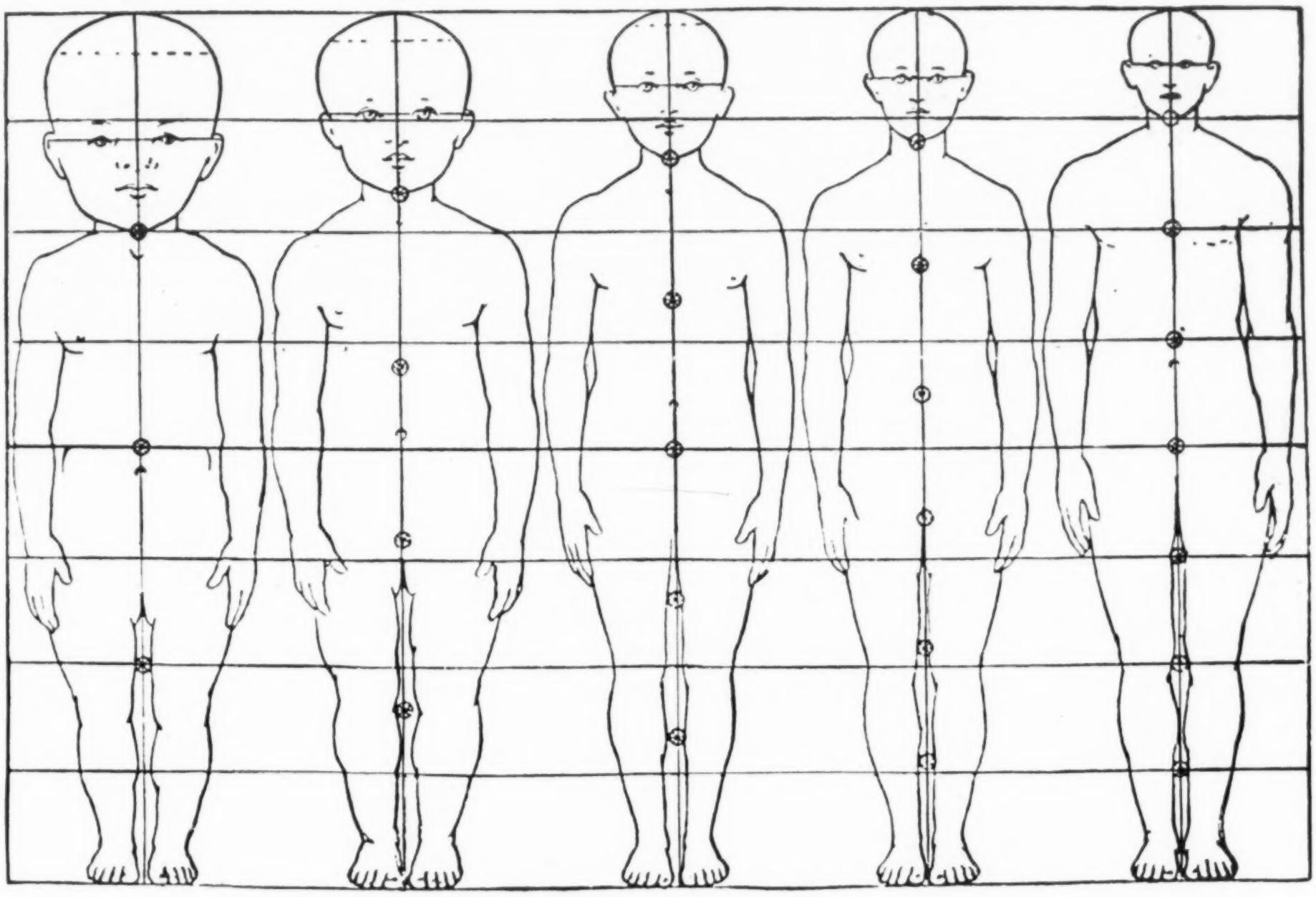
UNDER DEVELOPMENT—OR DWARFISM

A certain type of dwarfism in which the bodily proportions remain infantile but where the mentality is normal or nearly so, is termed ateliosis. Cushing and others have attributed this condition to an under development of the anterior lobe of the hypophysis. In these cases the ends of the bones remain separated from the main body of the bone by plates of cartilage long after the time when they should normally unite with it; but in spite of this there is a peculiar inhibition of growth and the bones all remain both short and slender. We have not as clear evidence that under development of the anterior lobe of the hypophysis produces dwarfism as we have regarding the influence of its over development in the production of gigantism.

The thyroid gland is definitely involved in another type of dwarfism termed cretinism. These cases are common in certain goitrous regions, especially among the southern Alps, and are often accompanied by that disease. It frequently entails idiocy. This condition results from thyroid insufficiency during childhood, and is the direct outcome of a failure of the ossification process in the cartilage plates near the ends of the bones. The latter fail to grow in length but may increase considerably in thickness. While cretinism differs from ateliosis in the fact that the body is more plump, the mentality low and the skin coarse and puffy and there is a general lowering of metabolism, yet there is a significant similarity between them in the retardation of the process of ossification. This is in line with the work of Mr. Terry done in this laboratory, in which he showed that a similar inhibition of ossification is produced in tadpoles as a result of removal of the thyroid gland. These skeletal features constitute merely a phase in the general infantile conditions. In ateliosis there is simply a failure to become physically mature, probably due to

A GROUP OF DWARFS CHIEFLY ILLUSTRATING ATELIOSIS

Ateliosis is the term used to describe "a certain type of dwarfism in which the bodily proportions remain infantile but where the mentality is normal or nearly so." Most of the dwarfs in the picture are of that type. Three—possibly four—illustrate achondroplasia (very large head and extremely short limbs); and one at least appears to illustrate myxoedema (coarseness of features). Note the text on the preceding and following pages for more complete statements of these conditions. In addition to experiments upon amphibians, it is being learned from a study of dwarfs and giants that the thyroid gland and the hypophysis (pituitary gland) "exert a profound influence upon growth and differentiation." Photograph from C. B. Davenport (in Genetics, Vol. 2). (Fig. 18.)



DIAGRAMS TO SHOW HUMAN BODILY PROPORTIONS AT DIFFERENT STAGES OF DEVELOPMENT FROM INFANCY TO MATURITY

Illustration from C. B. Davenport (in Genetics Vol. 2, page 350). (Fig 19.)

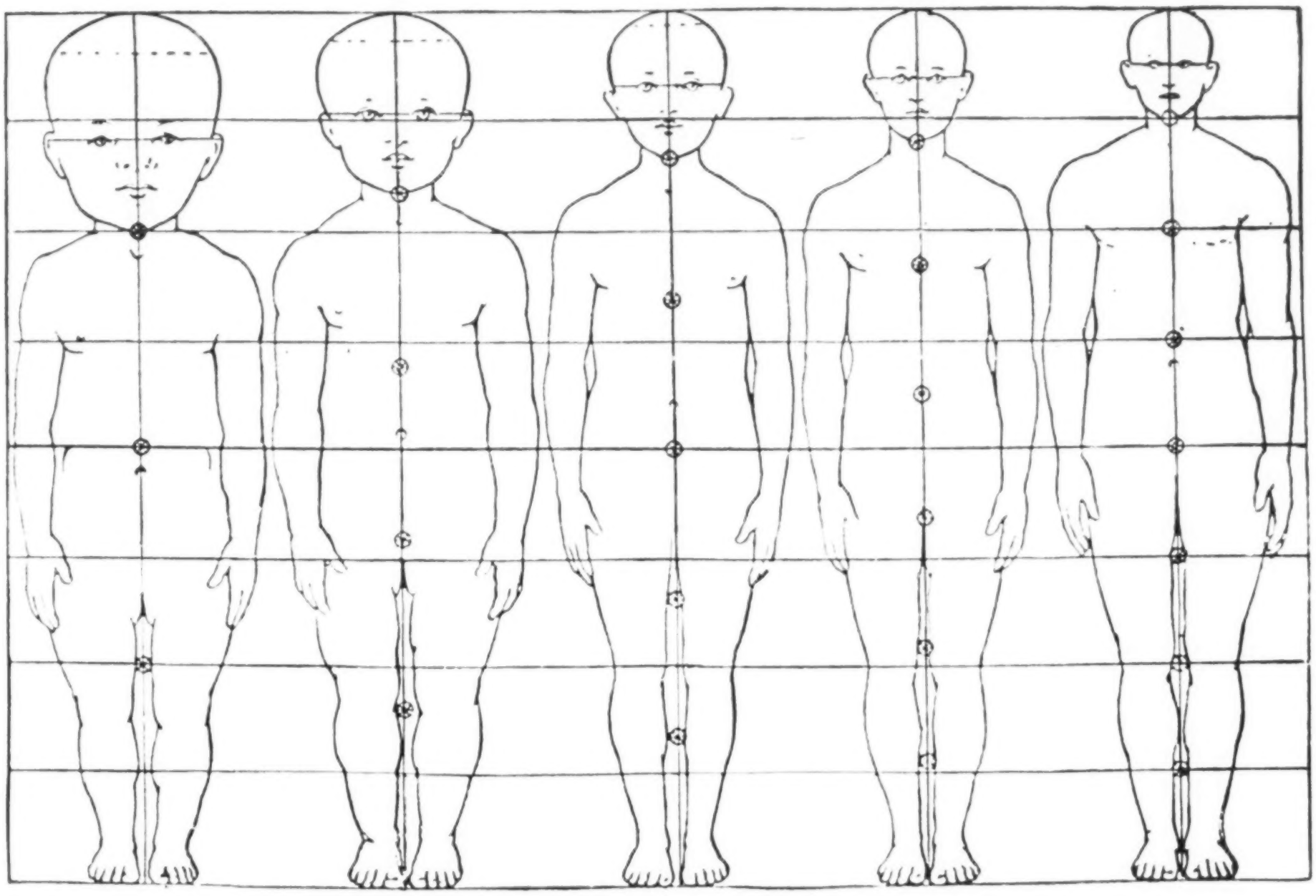
the under functioning of the hypophysis. This probably produces an under functioning of the thyroid gland to which the retardation in development would appear to be more directly due. Nevertheless the thyroid gland would seem in these conditions to function sufficiently to prevent the appearance of myxoedema seen in the cretin. In the latter cases the thyroid gland has been deeply diseased in childhood, not only involving a retardation in the development of the structural features and bodily proportions of maturity, but resulting in features of myxoedema as outlined above. The infantile proportions seen in ateliosis and cretinism involve a relative shortness of the limbs. This is quite in line with the very slight development of the limbs of tadpoles deprived of the thyroid gland, the pituitary gland or of both. It is needless to say that here in the tadpole we are also dealing with the maintenance of infantile tadpole characteristics. The similarity between these features in man and in the tadpole is more than a mere coincidence, it is in each case due to a retardation in bodily development.

These statements are made with the full recognition that they are partly based upon debatable data, but in the hope that they may lead to more accurate observations along these lines.

Achondroplasic dwarfs constitute a class quite different from the above. In them the trunk is little below normal size but the head is usually very large and the limbs extremely short. This differs from cretinism chiefly in the fact that there are no evidences of myxoedema and in the large size of the head, accompanied by hydrocephalus. The shortness of the limbs is also more marked than in cretinism, and intelligence is more nearly normal, often quite so. This condition manifests itself very early, usually in foetal life as shown in the difficulty of labor at birth. The cause of the condition is very obscure but may well be due to some abnormality of the thyroid or pituitary glands of either the foetus or

A GROUP OF DWARFS CHIEFLY ILLUSTRATING ATELIOSIS

Ateliosis is the term used to describe "a certain type of dwarfism in which the bodily proportions remain infantile but where the mentality is normal or nearly so." Most of the dwarfs in the picture are of that type. Three—possibly four—illustrate achondroplasia (very large head and extremely short limbs); and one at least appears to illustrate myxoedema (coarseness of features). Note the text on the preceding and following pages for more complete statements of these conditions. In addition to experiments upon amphibians, it is being learned from a study of dwarfs and giants that the thyroid gland and the hypophysis (pituitary gland) "exert a profound influence upon growth and differentiation." Photograph from C. B. Davenport (in Genetics, Vol 2). (Fig 18.)



DIAGRAMS TO SHOW HUMAN BODILY PROPORTIONS AT DIFFERENT STAGES OF DEVELOPMENT FROM INFANCY TO MATURITY

Illustration from C. B. Davenport (in Genetics Vol. 2, page 350). (Fig 19.)

the under functioning of the hypophysis. This probably produces an under functioning of the thyroid gland to which the retardation in development would appear to be more directly due. Nevertheless the thyroid gland would seem in these conditions to function sufficiently to prevent the appearance of myxoedema seen in the cretin. In the latter cases the thyroid gland has been deeply diseased in childhood, not only involving a retardation in the development of the structural features and bodily proportions of maturity, but resulting in features of myxoedema as outlined above. The infantile proportions seen in ateliosis and cretinism involve a relative shortness of the limbs. This is quite in line with the very slight development of the limbs of tadpoles deprived of the thyroid gland, the pituitary gland or of both. It is needless to say that here in the tadpole we are also dealing with the maintenance of infantile tadpole characteristics. The similarity between these features in man and in the tadpole is more than a mere coincidence, it is in each case due to a retardation in bodily development.

These statements are made with the full recognition that they are partly based upon debatable data, but in the hope that they may lead to more accurate observations along these lines.

Achondroplasic dwarfs constitute a class quite different from the above. In them the trunk is little below normal size but the head is usually very large and the limbs extremely short. This differs from cretinism chiefly in the fact that there are no evidences of myxoedema and in the large size of the head, accompanied by hydrocephalus. The shortness of the limbs is also more marked than in cretinism, and intelligence is more nearly normal, often quite so. This condition manifests itself very early, usually in foetal life as shown in the difficulty of labor at birth. The cause of the condition is very obscure but may well be due to some abnormality of the thyroid or pituitary glands of either the foetus or

the mother. Careful observations along these lines are much to be desired. It has been shown that dwarfism in its various forms tends to be congenital, as shown in Rischbieth and Barrington "Treasury of Inheritance."

CONCLUSIONS

The last quarter century has witnessed a most brilliant series of discoveries in cytology and heredity. We talk a jargon in which are heard such terms as Mendelism, allelomorphs, genes, sex-determination, sex-linkage, crossing-over, etc. We have built up an edifice of theory that is amazing and a bit bewildering to one who can not lay claim to being a specialist. Out of it comes one insistent impression, namely, that our fate is sealed at the time of union of egg and sperm—that our future is decreed in the chromosomes. It is no doubt true that the nuclei of the germ cells carry definite tendencies that interact upon one another to shape and direct development.

On the other hand it is equally true that other factors are at work shaping the course of development. Most prominent among these are the endocrine glands. The writer freely admits that the character and functional activity of these glands may be in large part determined by hereditary tendencies, yet disease and accident play at times a very important rôle. It has been clearly shown that development toward maturity in the tadpole of the leopard frog will proceed only to a certain point in the absence of the thyroid gland or of the anterior lobe of the pituitary gland. Having reached this point the process ceases. In the common toad this process of growth toward maturity continues to a somewhat later stage than in the frog and there ceases just as abruptly. Beyond these points there may be very slight further progress but it is practically negligible. It is interesting to note that:

1. The stage reached is a definite one peculiar to the species. Development up to this point is quite normal, leaving out of account a slight retardation in size growth in the absence of the pituitary gland.

2. This stage is reached equally in the absence of the thyroid gland, of the anterior lobe of the pituitary gland or of both, and further development is possible only in the case of

(a) transplantation of the missing gland or glands or

(b) feeding with thyroid gland material or

(c) feeding with large quantities of iodine.

Now the practical value of these discoveries lies in the fact that they show us ways not only of correcting certain types of abnormal size growth and development; but give us hope that we may some day modify what we consider to be normal growth and development. This may at some future time be carried out in a thoroughly practical way. While we can readily cause half grown tadpoles to quickly develop into little weazened frogs by feeding them thyroid preparations or iodine, it still remains to be seen how far we may stimulate them to size growth beyond the normal limits of the species by any process of administration of the anterior lobe of the pituitary gland. Uhlenhuth has shown that feeding pituitary preparations to Ambystoma causes giant growth in size. This fits in with our theories regarding the causation of gigantism.

We may be permitted the hope that through our knowledge of these glands we may be able to largely control the rate and extent of developmental and size-growth processes. May the writer be permitted in closing to again express his conviction that the amphibians afford the best opportunities for the accurate investigation of these questions. They should play a rôle in the study of these promisingly practical problems comparable to the part played by the insects in the field of cytology and experimental breeding. Indeed they are far closer home because they are vertebrates like ourselves—the forms nearest of kin in which these glands can be reached by operation at their inception, and in which feeding experiments may be carried on at an early stage of development.

AN UNUSUAL TYPE OF PROLIFERATION IN *AGROPYRON CRISTATUM*

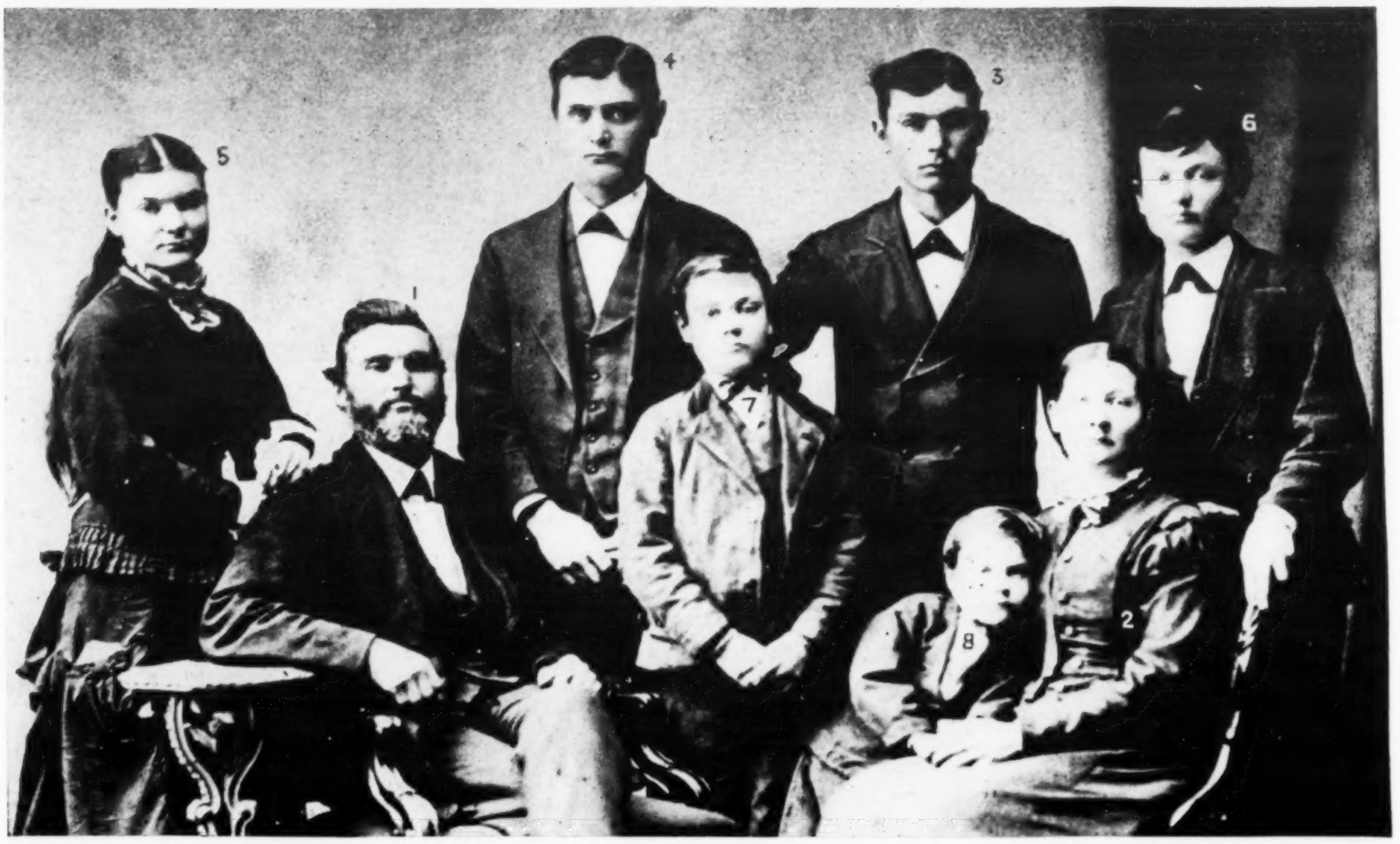
C. V. PIPER

The illustration shows a case of proliferation in *Agropyron cristatum* (L.) Beauv. which occurred in a plot of grass of this species at Redfield, S. Dak., in 1920. It will be noted that four of the spikelets are replaced by elongated leafy branches, a not uncommon teratological phenomenon in various species of Agropyron and other grasses, but in this example considerably longer than usual. In about twelve other spikelets the axis above the glumes is elongated and one or more of the lower lemmas appear as somewhat elongated bracts, the remainder of the spikelet being normal. In all of these modified spikelets the two glumes (empty glumes) remain unchanged—that is, exactly like those in the normal spikelets.

Proliferating spikelets—that is, those which elongate into leafy sterile branches—are very common in many grasses. Spikelets in which the axis elongates and only a few of the lower lemmas become sterile while the remaining ones remain fertile, seem not to have been reported. At least a search in the literature for such examples revealed no cases reported among grasses.

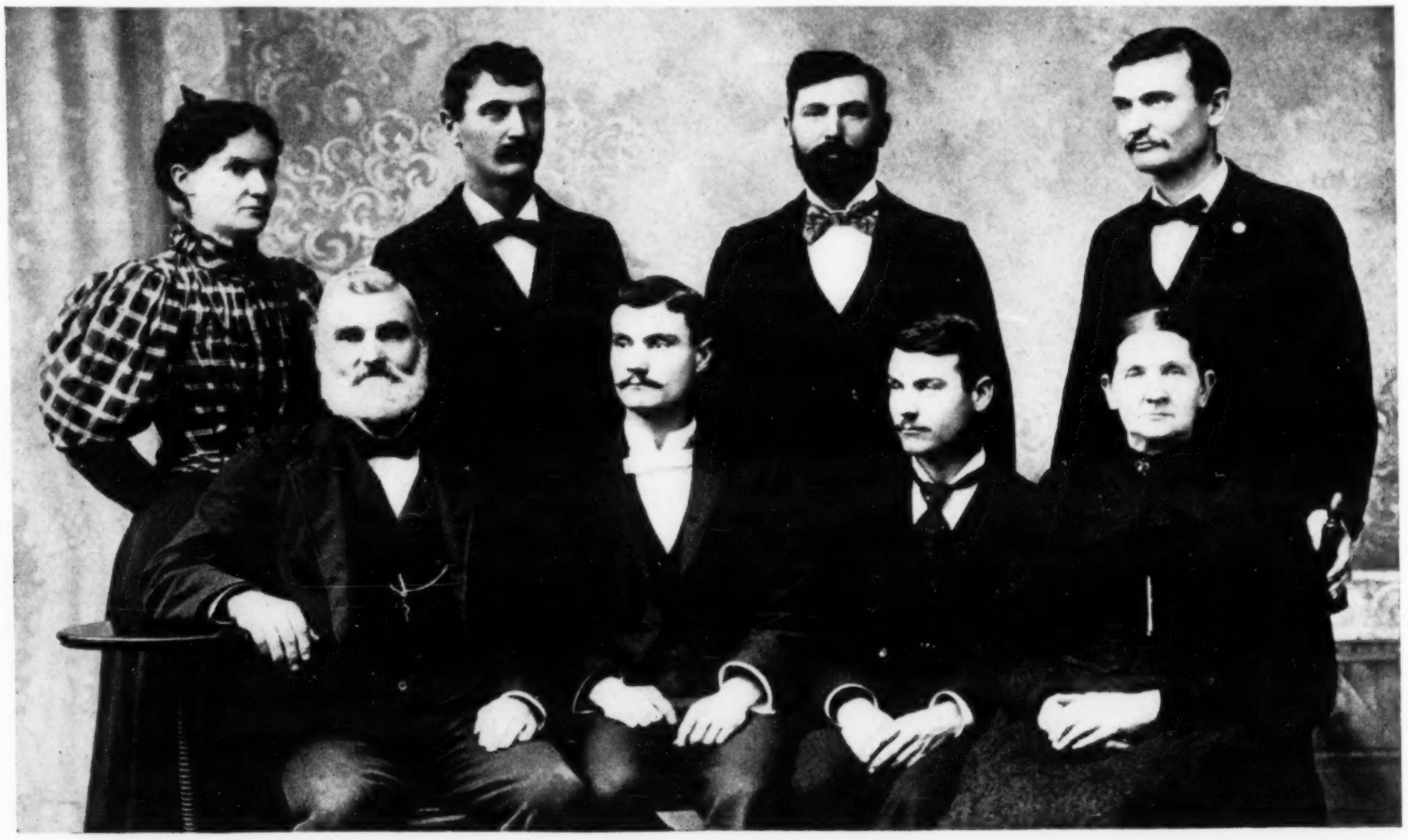
AGROPYRON CRISTATUM (L.) BEAUV.

1. Normal spike. 2. Normal spikelet. 3. Abnormal spike, four of the spikelets changed into leafy branches and twelve others each with the rachis elongated and the lower lemmas somewhat elongated. The glumes (empty glumes) remain normal in all the teratological spikelets. 4. Abnormal spikelet with the lower internodes of the rachis elongated. (Fig. 20.)



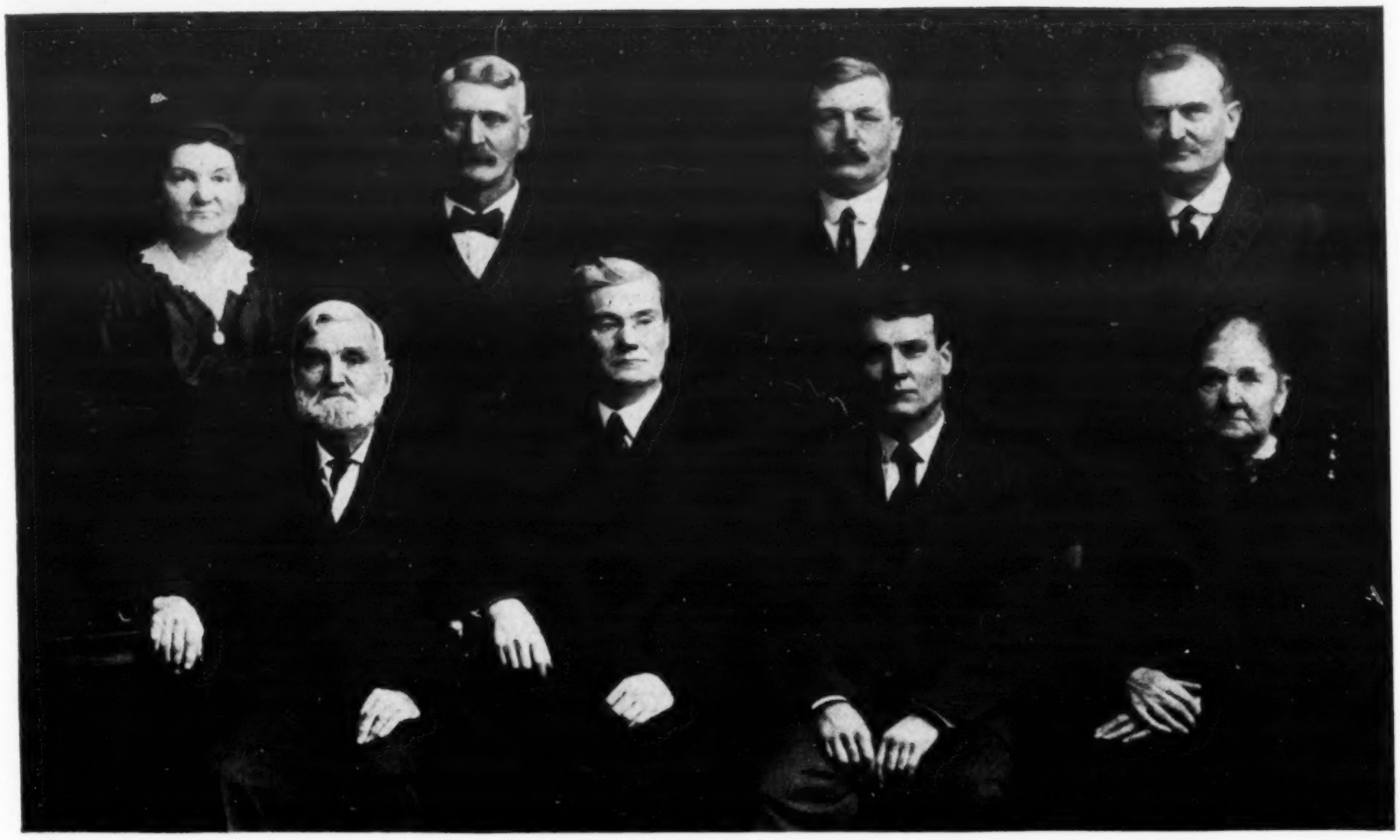
THE FIPPIN FAMILY IN 1876

Mr. and Mrs. James Fippin have this fortunate photographic record of themselves and their six children at three different periods, twenty years between each succeeding picture. In all three instances the members are shown in the same position. (Fig. 21.)



THE FAMILY MEMBERS IN 1896

James Fippin, the father in this group, was one of a family of three boys and two girls. One brother went to California where he settled with a large family; another brother also went to California with his family of eight children. The two girls married and lived in Ohio. All lived to notably old age. (Fig. 22.)



THE FAMILY AGAIN IN 1916

The six children shown with their parents in Fig. 21 and again in Fig. 22, are shown in this third photograph also in the same position. Forty years have elapsed since the first picture was taken. The "children" are now heads of families of their own, and the elder Mr. and Mrs. Fippin have 22 grandchildren and 25 great grandchildren. (Fig. 23.)

PHOTOGRAPHS SHOWING SAME FAMILY FROM YOUTH TO MATURITY

The three accompanying photographs are of the Fippin family. They are presented because of the rather unusual fact that they were taken twenty years apart—forty years between the first and last picture—with all the members of the family present in the same position in each picture. They are an interesting illustration of the unfoldment of personality over a span of forty years. James Fippin, (1) the head of the family, has lived for sixty years, just west of Columbus, Ohio, where he was a farmer. He was born in Belmont County, Ohio, January 31, 1833, and married Mary Shank (2) at Nashville, Ohio, March 16, 1854. After a few years at Nashville and a short residence in Indiana, they settled at what became with the opening of the Civil War, Camp Chase, and there the four younger of their six children were born.

John (3), the oldest son, (see numbers in the first picture) was a farmer for most of his life. Ambrose J. (4) was a farmer and carpenter. Mary Ann (5) married Frank P. Sperry, a seedsman; James E. (6) has been an accountant and banker; and Samuel (7) is an accountant, while Charles (8) is a mechanic. All now have families and reside in or near Columbus. There are 22 grandchildren and 25 great grandchildren.

The family has been unusually vigorous. Barring a period of severe rheumatism in his young manhood, both James Fippin and his wife have always been well. The latter died in October 1921 at the age of 87. The only other break in the family was that of Ambrose J. in 1919. Up to 1917 there had not been a natural death of any member of the family covering three generations. There were two accidental deaths.

James Fippin seems to be of English stock. His wife was a "Pennsylvania German."

THE SWAZEY BARBERRY

F. T. RAMSEY
Austin, Texas

I WAS born in 1861 near the edge of the "bad" Indian country, fifty miles north of Austin, Texas. At that time one could not go to a store and buy flower seed. But mother, on that sparsely settled, lonesome prairie, wanted flowers. The only ones to be had were the native wild annuals, perennials, and shrubs. I have inherited from my mother the joy she had in gathering those shrubs to beautify the grounds of her first home.

How much easier it is for one to appreciate the value of a plant or shrub from a foreign country, whether recommended for ornament or economic use, than it is to see these qualities in native plants growing wild around you that have never received any aid in combatting the robbing roots or the smothering shade of other trees, or the drouths and freezes and floods that come in irregular attacks.

It often takes real effort to see refinement and beauty in a plant that you know is hardly beyond description, one that can be called climate-proof. This means more to a person living in an arid western environment than in the more humid East.

A line drawn north and south through Central Texas, passing through Austin, is generally considered to be where the arid and humid sections meet. A great number of shrubs not found elsewhere appear along this line and westward; while west of San Antonio is nearly desert, it has been said that between the Colorado and the Rio Grande rivers there can be found more kinds of plants and shrubs than in any other equal area. A lot of these plants bear what is called the trade-mark of West Texas—thorns.

There are a hundred sorts of wild shrubs that can be used to make one's home grounds beautiful, comfortable and valuable. There are leagues of barberries with countless variations in their leaves and fruits. The Mexicans and ninety-nine per cent of other residents call them "Agaritas," while some people call them "Chaparral," a name which in different sections is applied to a dozen different shrubs—by some people to any shrub that is armed or prickly.

Few persons who have lived a lifetime in the range of *Berberis trifoliolata*, the three leaved barberry, have noticed that, in going toward the center of its wide range, they may find here and there a bush with five or more leaflets called *Berberis Swazeyi*. Coulter's Botany of West Texas says some of these plants have from five to nine leaflets. The accompanying photograph shows them with five, seven, nine, eleven, and thirteen leaflets, and we found one with seventeen.

The colors of the leaves are as varied as their shapes. Some are dark green above and silvery underneath, while the next bush may have these colors somewhat reversed. One will seem to imitate the silver or whiteness of "the old man's beard" on one side while on the other you may find one of a dozen shades of dark green or pea green, and so intense is the shade that they seem liquid in appearance. In spite of these differences when planted in a hedge and sheared they harmonize beautifully. They grow on any soil, and a sudden drop to zero temperature has no effect on them. I have never seen one dead from cold or drouth.

Whether or not all plants that have more than three leaflets should be called Swazeyi is a question for the botanists to settle, but the size and lateness of the fruit and the more upright growth of the bush distinctly separate this type from *trifoliolata*.

The Swazeyi berries of *Berberis Swazeyi* have scarcely begun to ripen when the last berry has ripened and fallen from the *B. trifoliolata*, which

A NEGLECTED FRUIT OF WESTERN TEXAS

Berberis Swazeyi, which grows wild in western Texas, merits attention because of its ornamental appearance, and the economic value of its edible berries, which are sometimes more than half an inch in diameter. It can be grown on almost any type of soil; it is not injured by zero temperatures, and it is very resistant to drouth. (Fig. 24.)

matures in April and May. The ripening period of *Swazeyi* extends to the end of June.

By spreading a sheet on the ground and cutting branches and whipping them together or paddling with a shingle, it takes but a few minutes to gather a gallon or a bushel of the berries. They make exquisite jelly.

The berries of *Berberis Swazeyi* are twice as large as those of *B. trifoliolata*, many of them measuring slightly over half an inch in diameter.

The bushes always bear some berries and rarely miss a full crop. I know one wild bush that has borne three gallons every year for thirty years except one.

A BEQUEST TO THE AMERICAN GENETIC ASSOCIATION FOR RESEARCHES IN HEREDITY

INSPIRED BY THE THOUGHT THAT "IT IS ONLY BY A GREATER KNOWLEDGE AND APPLICATION OF THE LAWS OF LIFE AND GROWTH THAT MAN CAN HOPE TO HASTEN HIS PROGRESS UPWARD"

THE strongest human instinct is that which perpetuates the race, and the highest of human ideals is the welfare of posterity. It is not lack of interest but lack of knowledge that interferes with eugenic progress. Not many people see the need, and there are very few who have a practical conception of the possibilities of improvement, to serve as a basis of constructive action. Charities and philanthropies of many kinds have had rich endowments for centuries, and espe cially "works of mercy" to care for the diseased or defective whose misfortunes wring our hearts. Few bequests have been made to increase the knowledge of heredity, although more knowledge is the fundamental need. Research in many subjects is being fostered by large donations, including subjects as far from any practical human interest as the remotest stars or the world of departed spirits. Yet we expect that our children and our children's children will go on living in this world, and we believe that the world will be a better or a worse place for posterity in proportion as right values of human life are established. The general lack of interest and support for human improvement renders it the more important that those who have deeper insight and keener sense of eugenic responsibility should seek for more effective ways of establishing and widening the influence of eugenic ideas.

The need of establishing better ideals of human welfare may be considered as the keynote of a remarkable testament received recently by the American Genetic Association. The way of making the bequest and the reasons that are given lend so much interest and value to this document that the testator has been requested to allow some parts of it to be published, and has given his consent, saying that "If anything I have written could be made the means of arousing new interest in any quarter I would be highly pleased."

Passing over the sections of the will that relate to appointment of trustees, settlement of obligations and personal bequests, the sections that explain the eugenic and educational convictions of the testator are as follows:

"I hereby give and bequeath unto the American Genetic Association located in the City of Washington, District of Columbia, the sum of ten thousand dollars, to be invested and reinvested by the Council of said Association and the net income therefrom to be used and applied by said Council without reservation for the increase and diffusion of knowledge regarding the laws of heredity. In the event, however, that the said American Genetic Association shall cease to exist or to continue engaged in the kind of endeavor for which this fund is bequeathed, the total amount of this bequest shall revert to the Smithsonian Institution located in the District of Columbia to be administered by the Trustees of said Smithsonian Institution in any way it sees fit for the increase and diffusion of knowledge regarding the laws of heredity. * * * *

"All of the rest, residue and remainder of my property, real and personal, and wheresoever situate, I give, devise and bequeath unto my trustee aforesaid, in trust, to carry out the provisions of this, my last will and testament according to my desires and wishes as hereinafter contained. * * *

"The fund created by the last paragraph of this will is to be devoted and used for beneficial purposes only, my wife and family and those coming after them to have the preference right

thereto, but never under any circumstances is such fund to be used wastefully or extravagantly or under such circumstances as to encourage idle or luxurious living. This property represents the savings of a lifetime of industry, economy, and self-denial, and I wish it to be used wisely and made to count for individual and race betterment.***

"As soon as my son is old enough for college, I desire that he be provided with the sum of $1200.00 per annum for his use during his college course, to meet his necessary expenses and to enable him to pursue his studies, but not to enable him to indulge in extravagancies or luxuries, should he happen to be so inclined. I hope that my son will marry early, say not later than the age of twenty-five, and trust that he will marry advisedly and know that his chosen mate comes from a family in which useful and capable men and women predominate. To assist and encourage him in his chosen pursuit or profession, I direct my trustee to pay to him at the time of his marriage the sum of five thousand dollars. I also direct that for each and every child born to him, before the termination of the trust created by this will, he be paid the sum of twenty-five hundred dollars as soon as each such child shall have attained the age of three years. Should my said son develop scholarly tastes and desire to devote his life to the pursuit of science and the acquisition of knowledge (and particularly along the lines of biology and genetics) and manifest a degree of ability along those lines (which might best be judged and determined by his original essays and papers appearing in scientific publications or by lectures before scientific bodies), then and in that case I desire that he have all of the money that he may need and use to advantage in the pursuit of the studies and researches, even to the limit of the income not otherwise appropriated. Should he desire to follow some business vocation in which capital is required, like agriculture, horticulture, live stock, mercantile or manufacturing pursuits, and manifest an ability in that direction, I desire that he be paid the sum of ten thousand dollars out of the income or principal of said trust when he shall have attained the age of thirty years, and, if he make progress in such pursuit or calling (my trustee to be the judge as to that) he shall receive ten thousand dollars additional when he shall have attained the age of forty years. If I shall have other sons who shall reach maturity, I desire that he or they shall receive the same benefits and that the same provisions shall apply as to each of them as are above provided for my present son.

"As to my daughter and any future daughters born to me, I desire that she or they shall have the advantage of a higher or college education, if such education be of a practical or beneficial kind, but I do not favor a smattering of music and art and the so-called accomplishments which often carry with them conceits, vanities and follies which later have to be unlearned at bitter cost. Neither do I want their minds taxed with the study of abstruse branches of learning which are of but little use and sometimes result in shattered nerves and weakened womanhood which lessens the possibility of happy and useful lives. I desire that they be taught the laws of health and beauty and how to preserve them; and also something of the laws of heredity. I desire also that they be taught that as this world was created for the evolution and development of man, their supreme duty and greatest glory consists in rearing of a family of noble sons and daughters; that the more nearly perfect they are themselves the greater the obligation which rests upon them in this respect. When it is remembered that college girls are frequently failures as wives and mothers; that recent statistics go to show that they average less than one child, each, it will be seen that I have good and sufficient reasons for not wanting to devote money to the conventional 'higher education' of women. A college education is a failure and race deterioration a certainty when the daughters of the best families in the

land fail in parentage. If my daughters desire the practical kind of education indicated, and there be an institution where such branches are taught my trustee is instructed to supply the means, otherwise nothing is to be expended for 'higher education.' At the time of marriage my trustee is instructed to pay to my daughter or daughters the same amount as provided for my son, and for each child born to her she is to receive the same sum to be paid according to the same conditions as above provided for my son. * * *

"In order to make myself better understood in this my last will and testament I desire first to explain that for many years I have held to the belief that wealth, especially great wealth, in the hands of any party should be regarded to some extent as a sacred trust for it has cost the life and labor of some one, perhaps of many, to produce it. While a man has a legal right to do as he pleases with what is his own, he does not always have the moral right to do so. Money or property wisely employed benefits the entire community, as well as the individual owner; unwisely employed it becomes a detriment to the community, and when devoted to idleness and luxury, or squandered in fast and riotous living it becomes a curse to the one who possesses it. This is so well understood by many that it has been well said that probably the worst thing that could happen to the majority of mankind would be to inherit wealth and to be relieved of the necessity of earning a living. Accumulated wealth in its power for good or evil might be compared to water gathered together in a storage reservoir; it can be made to turn the wheels of industry or irrigate a valley or do both at the same time, but uncontrolled and unguided it becomes a power for destruction, and out of its proper channel it soon becomes a torrent of mud, polluting and destroying everything in its path.

"Another thought which has possessed my mind for a long time is that every man should contribute something of his savings to some worthy cause, for it is only by so doing that we can repay the debt we owe to those sturdy pioneers of progress who by their unselfish efforts have, in all countries and ages, helped to make civilization possible. This thought has been confirmed and strengthened by the conviction, strong in my mind, that this world with its vast resources and powers, must have been created for a purpose, and that purpose must have been the evolution and development of man.

"The idea that the forces and powers of nature, chemical, mechanical and electrical and all of the vast supplies of coal, oil and minerals, were here to remain forever unused and unapplied, is to my mind unthinkable and as inconceivable as the idea of a great factory, equipped with modern machinery, being located in an uninhabited country.

"Man, then, being the object and purpose of creation, it becomes our duty to co-operate with nature in hastening the day of his perfection, for man is a creature of evolution, and still an unfinished product. To be as brief as possible, I am now convinced from some study and much thought, that it is only by a greater knowledge and application of the laws of life and growth that man can hope to hasten his progress upwards toward that happy day when weakness and sin will be reduced to a minimum and when the least efficient of mankind will be the equal of the greatest of today. Religion alone can never work this change, for polish and refine a man as you will, the work has all to be done over again with his son, for polish is not hereditary any more than the clothes a man wears. Religion at its best is but a crutch to help men walk, to aid the weak and wayward through this life.

"What the world needs is a race of men who are neither crippled in body or mind; for when men are born right, they will have no need to be 'born again.' Religion can help us to lofty ideals but we must look to science to

point the way to a realization of those ideals. Science has achieved wonders in the development of plants and animals, and it is high time now to turn attention to man himself, for he is subject to the same laws of life and growth. For thousands of years nature has been separating the sheep from the goats in her own harsh way. Under primitive conditions the weakest and least alert in body and mind were the first to fall, and progress was rapid. But nature is still on the job and while man today is no longer surrounded by wild beasts and savage foes with whom he has to battle with bare fists, yet he is surrounded with even more destructive and insidious foes in the form of temptations to excesses and indulgencies in hundreds of ways.

"We have all observed how quickly the savage races have fallen when suddenly exposed to the vices and temptations of civilization, and civilized man has by no means acquired immunity. In prehistoric times certain men and families were eliminated on account of their physical weaknesses and imperfections; now they are being eliminated for their vices and immoralities. Man killing monsters did the work then; fool killing vices do the work now.

"Under the earlier conditions man has refined physically; under the latter conditions he is being refined and perfected morally, for the man of the future must be strong in will power; the power of self direction and self control. The present age is perhaps the most critical and trying in man's career; it is a time when instinct is losing its hold and intelligence and will are not yet sufficiently developed to be a safe guide. As a race our present position might well be compared to that of the young man just out of college. Parents and teachers have done their part and his future success will depend largely upon his own efforts.

"As a race we have been reared in the lap of nature like other creatures, but the time has now arrived when our destiny is largely in our own hands and we must co-operate with all our strength to eliminate weakness and develop the "high minded man, with powers as far above dull brutes endued as brutes excel cold rocks and brambles rude." Race betterment is the all important work toward which our resources and energies should be directed and all other matters are significant only, or mainly, as they contribute to this grand purpose.

"I trust this brief philosophy of life will make me better understood by those who have known me and make my meaning clear in the foregoing disposition of my property."

Pseudo-Science

A Study of the Physical Vigor of American Women, by Edwin Elmore Jacobs, Ph.D., president of Ashland College and sometime fellow in sociology, Clark Univ. With an introduction by Charlotte Perkins Gilman. Pp. 60. Boston, Marshall Jones Co., 1920.

Dr. Jacobs seeks to prove the thesis that American women have become physically more vigorous in recent decades, and that this improvement is due to "release from former excessive household cares." This leads him to try his hand on some of the most formidable problems in the whole range of biology, with the result that he commits almost every sin enumerated in the "dont's for statisticians" and proves nothing at all. He presents some fragmentary, ill-interpreted, and often misleading data on women's diseases, the birth-rate, longevity and anthropological measurements, sizes of women's shoes, gloves, and corsets, and the participation of women in athletics. Very likely some parts, at least, of the American female population are improving in vigor. This may to some extent be due, as the author believes, to the declining birth-rate and the disappearance of home industries. But no light is shed on these questions by the book under review which, like very much of the "feminist" literature, is apt only to serve as a warning to a class in biometrics.—P. P.

WHAT IS MAN?

What is man? What is the defining characteristic mark of humankind? In the scheme of nature, what is the place—the distinctive place—of the human class of life? Have we propounded the question to ourselves? Professor Keyser thinks not, and in a brilliant address before the annual meeting of the Phi Beta Kappa Society at Columbia University discusses and expands a philosophy of life first sponsored by a Polish engineer, Count Alfred Korzybski.[1]

Humans, he points out, entertain two concepts of man, inherited in the mesh of inherited opinions; the one biological or zoological; the other mythological. According to the zoological conception man is an animal, a conception having at least the merit of regarding humans as natural—a merit not possessed by the mythological conception which accords man no place in nature, he being neither natural nor supernatural, but a kind of miraculous union or hybrid of the two.

Are these conceptions true? Or rather since they can not both be true, is one of them true? It should not be amazing to find that both are false; for the concepts are man's and their object is man; thus the difficulty is unique; it is that of a self-conscious being having to regard its kind as an object and rightly conceiving what the object is. If they are not true what is the error in these traditional conceptions? The error is believed to lie in a confusion of types. Plants, the lowest order of living things, are classed as the basic-energy-binding or chemistry binding class of life, while the animals are the space binders—the space binding class of life. What now of human beings, who, like the animals, have the capacity for binding space but with no capacity of a higher order would indeed be animals? The difference lies in the power of initiative, of creative ability, of imagination or reason, the power that makes progress possible, a power not possessed by animals. By virtue of that familiar yet ever strange human power, each generation inherits the fruit of the creative toil of bygone generations, augments the inheritance, and transmits it to the generations to come; then the dead survive in the living, destined with the living to greet and bless the yet unborn. Past, present, and future are not three; in man they are spiritually united to constitute one living reality and because this capacity *for binding time* under a law of ever-increasing amelioration is peculiar to man the class of human beings is to be conceived and scientifically defined to be the time-binding class of life. Not, as Professor Keyser points out, time binding animals, for time binding, chemistry binding, and space binding constitute three dimensions—three types of life to which belong man, plants and animals. Time-binding activity—the defining mark of man—may involve and often does involve space-binding as a higher involves a lower; but to say that, therefore, man is a species of animal—a time-binding species thereof—is like saying that a solid is a species of surface or that a violin is a species of wood or that symphony is a species of sound.

With this new conception of time binding, a study of man becomes the study of his time-binding energies; the laws of human nature are the natural laws of these energies. One of these laws is conceived as a law of perpetual growth and continued progress; a law of rapidly increasing geometric progression which reduces to the formula PR^{T-1} where P is the progress made in a given generation, R the ratio, and T the time. This then is the natural law for the advancement of civilization, only retarded in operation, the author believes, by the misconceptions man entertains of man, the misconception that man is but an animal and until man ceases to regard man as a species of animal the social life of the world and especially the ethical life will continue to be what it always has been in a large measure—zoological ethics.—J. H. K.

[1] Keyser, Cassius J., The Nature of Man, Science, Vol. LIV, No. 1393, pp. 205-213, Friday Sept. 9, 1921.